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CHRONOLOGY OF 'SALYUT-7' FLIGHT

[Editorial Report] The Soviet News Agency TASS reports the following information on activities connected with the flight of the "Salyut-7" space station.

6 Jul

After completion of the program of joint research with the Soviet-French crew, cosmonauts Berezovoy and Lebedev have spent the last days resting and preparing the "Salyut-7" station for further operations. A large part of today's schedule will be devoted to geophysical studies. The cosmonauts will perform visual observations and photography of regions of land and the oceans using spectral and radiometric apparatus and the MKF-6M and KATE-140 cameras. An orbital correction maneuver was performed on 3 July. Present orbital parameters of the station are: apogee, 344 km; perigee, 309 km; period of revolution, 90.8 minutes; inclination, 51.6 degrees. (Moscow PRAVDA in Russian 7 Jul 82 p 1)

9 Jul

Cosmonauts Berezovoy and Lebedev have completed their eighth week aborad the "Salyut-7"--"Soyuz T-5" complex. A large part of today's working time was devoted to technical experiments including methods for stabilization and orientation of the complex and measurement of the parameters of the atmosphere immediately surrounding the station. The cosmonauts also spend some time each day tending and observing the plants being grown in their space "greenhouses". Yesterday the cosmonauts underwent a scheduled medical examination. Studies were made of the condition of their cardiovascular systems as they exercised on the veloergometer. Physiological parameters were recorded by the "Aelita-01" multifunctional apparatus. Results show that both cosmonauts are healthy and they feel well. (Moscow PRAVDA in Russian 10 Jul 82 p 1)

10 Jul

At 1358 hours Moscow time on 10 July the automatic cargo ship "Progress-14" was launched. The mission of the cargo ship is to deliver expendable materials and various other cargo to the orbital station. "Progress-14"

was inserted into an orbit with the following parameters: apogee, 258 km; perigee, 192 km; period of revolution, 88.7 minutes; inclination, 51.6 degrees. (Moscow PRAVDA in Russian 11 Jul 82 p 1)

12 Jul

At 1541 hours Moscow time on 12 July the "Progress-14" cargo ship docked with the "Salyut-7"--"Soyuz T-5" manned orbital complex. Mutual search, rendezvous, mooring and docking were carried out by commands from the Flight Control Center and with the aid of on-board automatic equipment. The docking was monitored by cosmonauts Berezovoy and Lebedev. The cargo ship was docked on the side of the station's service module. "Progress-14" delivered fuel for the station's unified engine system, equipment and apparatus for conducting scientific research, materials for crew life-support, as well as mail for the cosmonauts. The on-board systems of the scientific research complex are functioning normally. (Moscow PRAVDA in Russian 13 Jul 82 p 1)

14 Jul

Cosmonauts Berezovoy and Lebedev have now completed two months aboard the orbital complex. They are continuing to unload the "Progress-14" cargo ship. A large amount of material has already been transferred to the station. This includes food products, regenerators for the life support system, and additional equipment and apparatus. Today the tanks of the unified engine system are being filled with fuel and drinking water is being pumped from the cargo ship to the tanks of the station. Today's program also includes observation and photography of land and ocean areas and physical exercise on the multipurpose trainer and the running track. (Moscow PRAVDA in Russian 15 Jul 82 p 1)

16 Jul

The crew is completing unloading operations on the "Progress-14" cargo ship. Preparations have been completed for refilling the station's tanks with oxidizer from the tanks of the cargo ship. A large part of the day will be devoted to medical studies, including study of the cardiovascular system with simulation of hydrostatic pressure by means of the "Chibis" vacuum suit. The "Aelita-01" and "Reograf" apparatus will be used to record physiological parameters. A study of cardiac activity by the ultrasound method is also planned. Biological experiments to study higher plant growth in conditions of orbital flight are also continuing. Today the atmosphere in the "Oazis" space greenhouse was exchanged. During the day the cosmonauts will also carry out the next scheduled cycle of observations of the earth's surface as part of the program of research on natural resources and study of the environment. (Moscow PRAVDA in Russian 17 Jul 82 p 1)

20 Jul

Cosmonauts Berezovoy and Lebedev have now been aboard the "Salyut-7" station for 68 days. The work planned for this period of the program has been carried

out successfully. The cosmonauts have completed unloading of supplies and equipment from the "Progress-14" cargo ship. Fuel and oxidizer have been pumped from the cargo ship into the tanks of the station. In the course of the day the crew will carry out preventative maintenance operations on the station and will perform physical exercises on the multipurpose trainer. In the second part of the day they will conduct astrophysical experiments using the French "Piramig" apparatus. According to medical monitoring and reports from the crew, the cosmonauts are in good health and are feeling well. (Moscow PRAVDA in Russian 21 Jul 82 p 1)

23 Jul

The tenth week for cosmonauts Berezovoy and Lebedev aboard the "Salyut-7" station is coming to an end. The crew has carried out the latest scheduled cycle of visual observations and photography of regions of the Soviet Union using the MKF-6M and KATE-140 cameras and spectro- and radiometric equipment. The survey was conducted while the orbital complex was over regions of the Ukraine, the Caucasus, the Black and Caspian Seas and republics of Central Asia. In the past few days experiments have also been performed to measure the optical density of various layers of the earth's atmosphere and to study its chemical composition. In the program of today's medical experiments the cosmonauts will study the cardiovascular system while performing physical exercises on the veloergometer. Time has also been scheduled for checking various systems, instruments and apparatus. (Moscow PRAVDA in Russian 24 Jul 82 p 1)

27 Jul

Cosmonauts Berezovoy and Lebedev have now spent 75 days aboard the "Salyut-7" station. In recent days the flight program has included astrophysical and biological experiments, visual observations and photography, and tests of equipment and scientific apparatus. A cycle of research with the X-ray spectrometer has been carried out to observe new X-ray sources of galactic and extra-galactic origin and to obtain additional data on known stars. In the program of biological research an experiment scheduled for four days is continuing in the "Biogravistat" unit to study development of higher plants in conditions of artificial gravity. The cosmonatus have run a control check on the electron photometer which was manufactured in Czechoslovakia and is designed to study the dust layer formed by micrometeorite particles in the earth's atmosphere. Visual observations of the dust layer were performed on the "Salyut-6" orbital station in 1978 as part of the work of the international Soviet-Czechoslovak crew. A large part of today's activity will be devoted to functional checks of equipment and systems of the station and to work with the technical flight documentation. (Moscow PRAVDA in Russian 28 Jul 82 p 1)

30 Jul

The crew of the "Salyut-7" station have now been in flight for 78 days. In accordance with the planned flight program, today cosmonauts Berezovoy and Lebedev performed a spacewalk.

The EVA was carried out in order to disassemble and partially replace apparatus which had been installed on the external surface of the station and which had completed its scientific functions and also in order to study possibilities for performance by the cosmonauts of various technological operations outside the station.

Preparations for exiting the station and work in open space were carried out in several stages. The cosmonauts put on their spacesuits in the transfer compartment of "Salyut-7", checked their air-tightness and at 0639 hours Moscow time they opened the external hatch. Valentin Lebedev exited the station and moved to the planned work zone. Crew commander Anatoliy Berezovoy, from a position in the open hatch, monitored the actions of the flight-engineer, assisted him in his work and made a television report of the activity with a portable camera.

The cosmonauts detached and brought into the station a device for recording micrometeorites and panels with biopolymers, optical materials and various structural materials which had been outside the station since it was inserted into orbit on 19 April of this year. In place of the units they removed, the crew installed new, analogous units.

In the course of the work in open space, the cosmonauts performed a number of technological operations in order to evaluate the efficiency of using thermomechanical and threaded connecters made from different paris of metals. Similar mechanical junctions may be used in the assembly of future space apparatus in orbit.

In the process of the EVA, tests were continued on the semi-rigid type spacesuits which have been improved on the basis of the experience obtained from the work in open space by crews of the "Salyut-6" station. The cosmonauts also tested new tools designed for assembly operations outside the station.

The total time spent by cosmonauts Berezovoy and Lebedev in open space amounted to 2 hours and 33 minutes.

After completing the planned work, the cosmonauts returned to the transfer compartment, closed the hatch, repressurized the compartment, removed their spacesuits and transferred to the basic quarters of the station.

Cosmonauts Berezovoy and Lebedev are feeling well after their work in open space. This successful experiment by the "Salyut-7" crew provided new scientific data and confirmed the high efficiency and reliability of the spacesuits and technical equipment designed for work in open space by the cosmonauts.((Moscow PRAVDA in Russian 31 Jul 82 p 1)

3 Aug

Several cycles of astrophysical studies have been completed to obtain new data on X-ray sources. A large part of yesterday's program was devoted to

medical studies. The flight program for today is devoted basically to studies of earth resources and the environment. The crew will use the MKF-6M and KATE-140 cameras to photograph regions of Belorussia, the Crimea, the Caucasus, the Pamirs, the Black and Caspian Seas and areas of the Atlantic and Indian Oceans. Experiments to study plant growth in orbital flight conditions are also continuing. Peas, wheat and onions are being cultivated in the "Oazis" and "Vazon" space greenhouses. The cosmonauts are in good health and both are maintaining high work capacity. Work in orbit is proceeding in full accordance with the flight program. (Moscow PRAVDA in Russian 4 Aug 82 p 1)

6 Aug

The twelfth week for cosmonauts Berezovoy and Lebedev aboard the "Salyut-7" scientific station is coming to an end. In recent days the cosmonauts have performed astrophysical studies and have carried out the "Rezonans" (Resonance) experiment to determine dynamic characteristics of the orbital complex. They have also photographed areas of the earth's land and ocean surface. An X-ray spectrometer was used to study characteristics of a variable source near the center of the galaxy and the powerful X-ray object Cygnus X-1. A biological experiment was completed in the "Magnitogravistat" unit to study the development of higher plants in weightlessness under the influence of an artificial magnetic field. Shoots of flax were used in this experiment. Biological experiments in the "Oazis", "Vazon" and "Svetoblok" greenhouses are also continuing. (Moscow PRAVDA in Russian 7 Aug 82 p 1)

11 Aug

At 0211 hours Moscow time today the "Progress-14" automatic transport ship separated from the "Salyut-7"--"Soyuz T-5" complex. The process of undocking and separation was monitored by specialists at the Flight Control Center and by cosmonauts Berezovoy and Lebedev. All planned operations for refueling and resupplying the station had been fully carried out. Cosmonauts Berezovoy and Lebedev are now in their ninetieth day in orbit. Today's schedule includes technical experiments, physical exercises and a television report. Experiments are also continuing directed toward an in-depth study of various biological objects in conditions of space flight and to improve space systems for the cultivation of higher plants. In recent days the crew completed the latest scheduled cycle of observations and photography of regions of the earth's land and water surface. In these studies the cosmonauts utilized a chromaticity atlas on the station along with the visual and instrumental equipment in order to recognize natural objects. (Moscow PRAVDA in Russian 12 Aug 82 p 1)

13 Aug

Cosmonauts Berezovoy and Lebedev and Berezovoy have now been in orbital flight for three months. A large part of their time today was devoted to astrophysical research. Using the SKR-02M X-ray spectrometer and a special time analysis unit the cosmonauts studied characteristics of the X-ray

radiation of Cygnus X-1 and of a variable source in the constellation Ophiuchus. The cosmonauts will also perform physical exercises during the day and will make a tape recording of their electrocardiograms. The flight of the "Progress-14" transport ship, which was orbited on 10 July 1982, ended today. At 0529 hours Moscow time the ship's engine was activated. "Progress-14" entered a descent trajectory and in the dense layers of the atmosphere over the Pacific Ocean it ceased to exist. (Moscow PRAVDA in in Russian 14 Aug 82 p 1)

17 Aug

Cosmonauts Berezovoy and Lebedev have been working in near-earth orbit for 96 days. Medical specialists constantly monitor their state of health and periodically conduct comprehensive medical checks. Yesterday the "Aelita-01" multifunctional recording apparatus was used to study cardiac bioelectric activity while the cosmonauts performed exercise on the veloergometer. The "Ekhograf" ultrasound apparatus was also used to evaluate the condition of the cardiovascular system in weightlessness and a number of biochemical studies were performed. According to the results of the examination, the cosmonauts are in good health. The commander's pulse rate is 60 beats per minute; the flight engineer's rate is 70 beats per minute. Their arterial pressures are 110 over 60 and 115 over 75 mm Hg, respectively. Biological experiments aboard the station are continuing. The cosmonauts reported that the arabidopsis plants being grown in the "Fiton" apparatus have completed a full development cycle and have produced seeds for the first time in conditions of orbital flight. According to telemetry and reports from the crew, all on-board systems of the orbital complex are functioning normally. (Moscow PRAVDA in Russian 18 Aug 82 p 1)

CSO: 1866/4-P

TASS REPORTS TERMINATION OF FLIGHT OF 'SALYUT-6' STATION

Moscow PRAVDA in Russian 30 Jul 82 p 1

[Text] The flight of the "Salyut-6" orbital scientific station which lasted for four years and ten months has been completed.

Scientific research and experimentation programs by five basic cosmonaut crews and eleven visiting crews were successfully carried out on the "Salyut-6" station. The total operating time of the station in manned regime was 676 days. Thirty-five dockings were performed with manned and automatic craft. Tests of the improved "Soyuz T" transport ship were conducted jointly in flights with the station. The system of supplying the station by means of "Progress" automatic cargo ships fully justified itself. The repair and maintenance work performed made it possible to increase the service life of a number of on-board systems, equipment and apparatus and to significantly prolong the period of active operation of the "Salyut-6" station.

Flights of nine international crews with participation of citizens of the socialist countries were carried out on Soviet "Soyuz" spacecraft and the "Salyut-6" station.

A large amount of information of various kinds was obtained in the course of carrying out the scientific program, which included studies of the earth's surface and atmosphere, technological experiments to obtain new alloys in conditions of weightlessness, astrophysical, biomedical and technical experiments. The results of this research will find wide application in various branches of the national economy, science and technology of our country and other socialist countries who are participants in the "Intercosmos" program.

After completion of the program of manned operations on the station, further tests were conducted on the on-board systems, units and equipment in conditions of prolonged orbital flight. In particular, the joint flight of the "Salyut-6" station and the "Cosmos-1267" artificial satellite continued for more than a year.

In accordance with the planned program, in the concluding stage of the flight final checks were made of the station's on-board systems and units and on

28 July a trajectory correction of the "Salyut-6"--"Cosmos-1267" complex was carried out using the station's propulsion unit. On 29 July the complex was oriented in space and at the calculated time the braking motor of the "Cosmos-1267" satellite was activated. After braking, both spacecraft went into a descent trajectory, entered the dense layers of the atmosphere over the targeted are of the Pacific Ocean and ceased to exist.

The flight of the "Salyut-6" scientific station was an important stage on the path toward creation of permanently operating manned orbital complexes.

CSO: 1866/146-P

FEOKTISTOV ON DEVELOPMENT OF 'SALYUT-7'

Moscow PRAVDA in Russian 16 May 82 p 3

[Interview with Konstantin Petrovich Feoktistov by V. Gubarev, PRAVDA special correspondent; Flight Control Center, date not specified]

[Text] At this very moment, cosmonauts Anatoliy Berezovoy and Valentin Lebedev are preparing to conduct their first experiment on board the "Salyut-7." Behind them are the exciting hours when the "Soyuz T-5" craft was flying toward its rendezvous with the station, the "El'brusy" was being transferred to its home in space and the "Salyut-7" station's systems were being tested.

One of the creators of the "Salyut-7" was K.P. Feoktistov, Hero of the Soviet Union, USSR pilot-cosmonaut and designer. From the launch of the ship to the new stage of the manned complex's operation in orbit, Konstantin Petrovich has been at the Flight Control Center. His calmness makes it obvious: he is certain that the beginning of the new space expedition will go as planned.

[Question] You had no doubts about its success?

[Answer] I am an optimist, although in our business--as in any other--the path to optimism is a thorny one. The birth of new technology is always a troubled one, but on the whole our capabilities are now incomparably greater than before. And we must use them.

[Question] Than before? But during those launches didn't you worry more?

[Answer] No doubt about it! But that was also a holiday for everyone. I cannot imagine an event in cosmonautics capable of exciting people--all mankind--as much as the launch of Yuriy Gagarin...

[Question] How about a manned flight to Mars?

[Answer] I doubt that there is any need for one right now. It would be another matter if there were life there, in any form--even the simplest amoeba--and automatic equipment could not deliver it to Earth. Then it would make sense for cosmonauts to fly there. For the time being, however, our main goal is to learn more about space in general and the Solar System in particular. We must determine just what types of work cosmonauts can do better and what types should be done by automatic

equipment. I have in mind near space, not deep space. By the way, from near-Earth orbits it is possible to perform a huge number of experiments that are impossible under terrestrial conditions.

[Question] And, therefore, many astrophysical experiments are being conducted?

[Answer] Of course. One of today's most important goals is the insertion into near-Earth orbits of different kinds of observatories. We need to pay more attention to astronomical satellites. With their help we have obtained startling scientific results. In satellites, however, we still install only small instruments, whereas large telescopes can be carried by stations. Our experience in operating the "Salyut-6" confirmed this possibility. I am "keen" on astrophysics, and would hope that right now--not in the remote future--such investigations could be conducted more extensively. Some of them have been planned for "Salyut-7."

...Konstantin Petrovich is carried away. He begins to talk about future orbital stations in which there will be gigantic radio telescopes, shops for producing semiconducting materials, biological scientific research centers. Long ago I noticed this feature in the character of this designer: after outlining the general features of upcoming experiments, he immediately begins to think about the next decade of cosmonautics. That was 20 years ago, then 10...I will not conceal, for example, that when we talked about the first orbital stations (which then existed only in drawings), it seemed to me that Konstantin Petrovich was fantasizing too much. But after only a few more years passed, many of these prognostic dreams were realized. This is not only a feature of Feoktistov's character, however, but is also the basis of his work as planner and designer.

As far as the "Salyut-7" station--entered on 14 May by A. Berezovoy and V. Lebedev--is concerned, there is a huge amount of work that Konstantin Petrovich must do, and he will travel regularly to the Flight Control Center. However, he also has other concerns: the next station, which is only beginning its path into space...

[Question] I recall that soon after the launch of the "Salyut-6" in the winter of 1977, preparations were being made for the launch of Yu. Romanenko and G. Grechko, the crew for the first extended expedition. In particular, the crew was to check the state of the station's docking assembly: could it receive spacecraft? Your calmness at the time astonished me, Konstantin Petrovich.

[Answer] We understand perfectly that we have no guarantee that there will not be isolated errors and failures. Our equipment is actually produced as single models. This means that it is always possible to "encounter" an unexpected failure. The tests are thorough and careful, it is true, but a hidden defect cannot always be detected, since there are thousands of parts and asemblies. Therefore, we also say that the cosmonaut's profession is that of a tester: essentially, each flight is the first one. Although such errors are unpleasant, they do not affect the main goal, which is to select the correct direction in our field. When it is necessary to take a fundamentally new step--those are the hardest times for planners and designers. There an error is not permissible. And it is a pleasant thing that for a quarter of a century we have succeeded in making correct design decisions that have largely determined the development of our technology. Just imagine: it is late 1959 or early 1960. "Vostok" has not yet flown, but we have already chosen a group that was beginning to concern itself with the rendezvousing of ships in space. The

lads in the group were a little hurt: the work on a ship for a manned flight was in full swing, but they had to switch to a new project. Then "Soyuz" appeared, and right there the idea of an orbital station was born. Sergey Pavlovich Korolev, an extremely talented scientist and organizer, understood perfectly that in addition to our concern about tomorrow it is also necessary to think about the day after tomow-row, because time passes rapidly.

[Question] Does this mean that operations in orbit with the "Salyut" had not yet begun and you were already concerned with a new station.

[Answer] Absolutely.

I remember how 1977 passed and the hatch into "Salyut-6" still had not been opened even once. It would have been difficult to believe that 5 extended expeditions, lasting 94, 140, 175, 185 and 75 days would take place in this orbital station! Almost 30 cosmonauts worked on board the "Salyut," 9 international crews were launched from Baykonur, and there were dozens of dockings and redockings, numerous orbital corrections and hundreds of scientific experiments...

[Question] The question naturally arises: to what extent is the experience gained with the "Salyut-6" incorporated in the new station?

[Answer] In such a short period of time it was impossible to make fundamental changes in the design. During the flight, however, the cosmonauts did much prophylactic work, with some of it being quite complicated. This experience was priceless. I think you will understand me correctly if I say that we are making every effort to make it easier for man to work in space. This applies to the new station, also. For example, in the "Salyut-6" there arose the necessity of replacing the pumps in the heat regulation system. The flight of L. Kizim, O. Makarov and G. Strekalov was necessary largely because of these pumps: they opened the heat regulation system's liquid circuit and "fitted" new pumps in it. This was critical and difficult work. I assume that it will not be necessary to repeat it in "Salyut-7," but the design of the circuit has still been changed and installation of the pumps is much simpler. There are many such improvements in "Salyut-7."

[Question] From your viewpoint, what was the main result of the work accomplished with the "Salyut-6."

[Answer] Much has already been said about the scientific side. The fundamental achievement, which led to the others, was the organization of the delivery of a large number of loads into orbit. The creation of an Earth-space-Earth transportation bridge makes it possible to solve practically any scientific and applied problems. By the way--and this is of no little importance--the cost per kilogram of useful load delivered into orbit is decreasing.

[Question] Is cosmonautics also the concern of the bookkeepers?

[Answer] Naturally. It is necessary to try to reduce expenses. In cosmonautics, in the end--particularly in the future--one of the primary factors is economics. I am firmly convinced that the path we have selected, which is the creation of orbital complexes and a system for freight turnover between the Earth and orbit is unarguably fully profitable at the present time.

[Question] And what can we expect in the future?

[Answer] We are making ourselves at home in space in the "Salyut" stations. Not only are we obtaining concrete results, but we are learning to do those types of work that will be commonplace in cosmonautics in the 21st Century.

[Question] What was the most complicated factor in the creation of the "Salyut-7."

[Answer] As with any space technology, testing in every way possible. First the individual assemblies and systems in experimental installations, then the station as a whole. When the testing cycle at the plant was completed the station was sent to the cosmodrome, and there it began again. In the testing and assembly unit, the launch vehicle and the station were tested separately and then together, they were taken out to the launch pad and so on...tests, tests, tests...everything that could be tested had to be tested on Earth!

I saw one of the stages of the preparations for the launching of the new station, at the testing and assembly unit at the cosmodrome. The solar batteries--the station's wings--were attached to their future space home. The testers opened and closed the the wings dozens of times, all in order to insure that in space, immediately after the station went into orbit, they would open once.

[Question] Konstantin Petrovich, you participated in the creation of the first specimens of Soviet space technology, more than two decades ago. What, in your opinion, have been the fundamental changes? I have in mind not the complexity of the technology itself, but the principles behind the work.

[Answer] We are evaluating our capabilities more soberly. Some of the enthusiasm has been lost.

[Question] What do you have in mind?

[Answer] I remember when they told me that the first parts of the shell of the "ball"--that is, the "Vostok's" descent vehicle--had appeared in the shop. I ran over there enthusiastically so I could touch the actual metal. And when I caught sight of the first model of the ship's electrical "filling," even though it was not yet installed--the hull stood by itself and the engines and instruments were lying on tables--I was frightened at the number of cables. Then I though: can this whole thing work together? You have probably heard that we called that section of the shop "tarzannik" [probably "Tarzan country"]. There were so many cables and wires that it was easy to get tangled up in them, and it was as if we were in a jungle. We now understand that the material that then struck us as being so complicated was actually extremely simple.

In future years, a designer will probably call the "Salyut-7" station "extremely simple." There is a regularity about this: space technology is developing at a very rapid rate. Heroism and personal courage will never fade, however, and it is precisely these qualities that will build the road to the future. Today Anatoliy Berezovoy and Valentin Lebedev are doing their bit, about which the poet said figuratively: "This is the next piling for the bridge into space."

11746
CSO: 1866/97

LAUNCH OF 'ISKRA-2' SATELLITE FROM 'SALYUT-7'

Moscow PRAVDA in Russian 18 May 82 p 6

[Article by V. Gubarev, PRAVDA special correspondent: "Son of 'Salyut'"]

[Text] Right now it is flying behind the station like a tiny but bright star. If one looks through the window, it seems like the satellite is right there and can be touched merely by reaching out one's hand. However, with every hour and every revolution around the planet the distance is increasing, and probably as early as tomorrow Lebedev and Berezovoy will not be able to distinguish the little star they created against the dark background of the sky. The son of "Salyut," as predicted by ballisticians, is following its own road in space and will begin an independent life. On the other hand, the satellite announced its appearance in space immediately, after it had barely left the station.

The appearance of this manmade body in space was not entirely normal, although for Soviet cosmonautics the "launching" of such satellites is now an ordinary occurrence. And it does not surprise us, because "Salyut-7" is in orbit and Anatoliy Berezovoy and Valentin Lebedev are working in it so that new lines can be written in the pages of Soviet cosmonautics.

The "Iskra-2" satellite was built by the Student Design Office of the Moscow Aviation Institute (MAI), that same MAI where many of the prominent scientists and designers who became pioneers of space technology and cosmonautics studied and taught. One of the participants in today's events--Valentin Lebedev--was himself graduated from MAI.

On television he shows us the "Iskra," the actual satellite that will be sent into space in just a few minutes. On it are the badges of young people's organizations from the socialist countries: young designers, specialists and students who timed the creation of the satellite for the 19th VLKSM [All-Union Lenin Young Communist League] Congress.

Anatoliy Berezovoy checks the satellite's power and turns its systems on for a few seconds. On board the "Salyut-7" there is a special panel--also built at MAI's Student Design Office--for checking the "Iskra" before it is launched. The cosmonauts place the satellite in the left airlock.

There are two Flight Control Centers in operation: ours and the "student" one. On command from Earth, the "Salyut-7"-"Soyuz T-5" manned complex orients itself in

space so as to launch the satellite behind the station, as if "dropping" it on the space road, so that after several days the complex and the "Iskra" will be separated by a rather large distance. By the way, right now there is quite a bit of lively traffic in this orbit: in addition to the "Salyut-7" and the "Iskra," the "Salyut-6"-"Kosmos-1267" orbital complex is flying ahead of them by several hours. Its testing continues, with a lot of tense work being done in the Flight Control Center.

Thus, everything is ready for the launch of the satellite. Anatoliy Berezovoy and Valentin Lebedev wait for orders from the shift on duty. It is necessary to place the "Iskra" in orbit in the Student Flight Control Center's radiovisibility zone, because that unit is the one that will be monitoring it.

The station passes over the Black Sea.

"Launch!" commands an operator.

The cosmonauts "shoot" the satellite out of the station.

A report arrives after 3 minutes: "There is a signal from the satellite!"

Thus, "Salyut-7" gave birth to a son--a new artificial Earth satellite.

And between those in space and the duty shift there began a conversation that is typical of the early days of a flight.

"A lot of work to do," sounds the voice of Valentin Lebedev. "We're unscrewing different screws, taking off covers and preparing the scientific equipment."

"We're trying to do everything a little bit faster," remarks Anatoliy Berezovoy.

"Don't hurry," the operator advises, "you're already ahead of schedule."

"That's nice," Lebedev ventures. "It would be worse if we were behind."

"Could that really have happened?"

"Thanks for the confidence," Berezovoy answers.

The flight director--Valeriy Ryumin has now replaced Aleksey Yeliseyev at this post--summed up the first few days of work by the "El'brusy" laconically: "As we had hoped, the crew was excellently trained and is acting flawlessly."

We did not bother the new flight director with questions. It was obvious that USSR Pilot-Cosmonaut V.V. Ryumin, twice Hero of the Soviet Union, was excited: it is one thing to fly oneself, but an entirely different matter to carry the full responsibility for the actions of the crew and the numerous services that support the work of the manned complex. The first time A.S. Yeliseyev was in charge, he worried his friends and colleagues, but--as expected--Valeriy Ryumin knows his responsibilities to the letter, and his mild excitement, which is both natural and understandable, merely indicates that for him, as for Berezovoy and Lebedev, a new space saga is beginning.

"The second day of work on setting up the station was completed on Monday," said Viktor Blagov, the deputy flight director. "On Sunday the crew was allowed to rest, although Berezovoy and Lebedev did do some work, just because they wanted to. For all practical purposes, the complex is ready for the conduct of the scientific experiments. All the systems necessary for the support of the cosmonauts' vital activities are functioning normally, and they encountered nothing that was unexpected. Anatoliy Berezovoy and Valentin Lebedev feel good, and from the time of the launch until today they have maintained a high degree of fitness for work, although right now is the most acute period of their adaptation to weightlessness. The station and the transport ship were injected into orbit quite well, so I have nothing to say about them. We are going forward according to the flight program"

11746
CSO: 1866/98

DEPUTY FLIGHT DIRECTOR ON UNLOADING OF 'PROGRESS-13'

Moscow PRAVDA in Russian 30 May 82 p 3

[Article by V. Gubarev: "Fantasy? No, work..."]

[Excerpt] I am taking advantage of the break between communications sessions to conduct an interview with the deputy flight director, V. Blagov.

"The schedule for unloading 'Progress' is very compressed," he explained, "and this is natural, since we have the experience of the work on 'Salyut-6'. We are striving to increase the effectiveness of the crew's work, and hence those operations which can be carried out with a minimum of their participation will be accomplished by commands from earth. To be specific, refuelling the space stations previously took much of the crew's time. 'Progress-13' supplied fuel and an oxidizer. At the time of the flight of 'Salyut-7', no small amount of fuel was used--we made corrections in the orbit, various dynamic operations. Two pairs of fuel tanks and two pairs of oxidizer tanks were practically emptied. Now the unloading of the craft--conducted by the cosmonauts themselves, and the refuelling of the space stations--by commands from earth, can be accomplished simultaneously. The 'El'brusy' monitored the opening of the fuel mains and then once again were engaged with the cargo. For the first time in a semiautomatic mode, water was pumped over from a transport ship. 'Progress' delivered nearly 300 liters of water aboard the complex. Two tanks on the station had to be filled with water. The supplying of water and its use on board is now organized in a more rational manner. Simply stated, many processes on 'Salyut-7' have been automated, and this makes it possible to condense the program, to increase its effectiveness. On this flight the time to 'process' the cargo of the craft was shortened. 'Progress-13' will spend much less time docked at the space complex than its predecessors. This is achieved by a common effort--of the crew and of the ground support."

12198
CSO: 1866/118

BEREZOVOY AND LEBEDEV COMMENT ON FIRST MONTH IN ORBIT

Moscow PRAVDA in Russian 13 Jun 82 p 3

[Article by V. Gubarev: "A Month in Orbit: Conversation 'Earth-Space'"]

[Text] The "El'brusy" were listening to the nightingales. The recording was broadcast on board just after they arose. Anatoliy and Valentin shaved and washed up. Then Berezovoy started to prepare breakfast, while the Moscow nightingales vied with each other, striving to please the cosmonauts. The recording was very good--they had been longing for this nightingales' concert for several evenings.

"They sing beautifully," observed Lebedev.

"The earth suddenly became closer," Berezovoy replied.

The orbiting complex flies over the Atlantic. The cosmonauts are eating their breakfast. "Light conversation" ensues.

"Which one of us will clean up the kitchen?"

"I will," replied Berezovoy. "Is that alright, Valentin?"

"Of course," the commander laughed, "next week is yours."

"You're not complaining about your appetite?"

"No, both my appetite and my spirits are excellent."

"Workers," added Lebedev.

"By the way, how do you feel about..."

"Very good," answered Berezovoy, not listening to the end of the question. "This morning we got up feeling just like we did during our preflight preparations."

"Did you sleep well?"

"I sleep better than at home, because the weightlessness is better than any feather-bed," said Berezovoy.

"Well, I wouldn't say better," corrected his comrade, Lebedev. "I'm still more used to home--a bed is a bed. But here you can still sleep normally--we're getting a good rest before each work day."

On the display screen in the main control room of the flight control center, the announcement flashed on: 10 seconds to the end of the sequence." We have time to bid farewell to the "El'brusy," to wish them a good flight.

As usual, the start of the next sequence is given over to the specialists. They refine the work program, advise the crew how to better conduct this or that scientific experiment. The "El'brusy" discuss what they had time to do when they had no communications with the control center.

Then a question to the commander of the complex "Salyut-7/"Soyuz T-5" was heard: "How do you evaluate your first month of work in orbit?"

"I can say personally, that we carried out every operation on the program the first time," replied Anatoli Berezovoy. "You know, this is most difficult. The space station is new, and everything done on it is for the first time."

...On the screen of the control center is a display, on which the stages of the flight are reflected. The most "popular" number on it is "1". A month ago the predominant one was "zero"...The start of the station itself, the launchings of the piloted craft and the transport craft, the dockings and undocking, a series of dynamic operations--it was necessary to carefully prepare for every experiment. Everything done on the flight was a first.

"It should also be taken into consideration that work and life on the station was also a first for us," observed Berezovoy. "There are many of the finer points which could not be taught in the preparation phase. There is no such simulator on the ground as a flying station."

"And the opinion of 'El'brus-2'?"

"To that which Anatoliy has said, I would like to add that we already feel at home on the station," said Valentin Lebedev. "To fly into space is one thing--to live there is completely different. Take some common ordinary things: how to prepare food, how to look after yourself. This is no simple matter; and in the first stage, the time spent on these everyday cares was considerable, and now--minimal. We mastered the station. The checkout of all the equipment was completed, we received the transport craft."

"What happened that was unexpected?"

"The earth's beauty was astonishing," replied Anatoliy Berezovoy. "And the station was very big. In an ordinary apartment on earth you don't remember everything, but here you must remember every small detail..."

"In space, much is different," laughed Valentin Lebedev. "From sleeping on the ceiling, to crossing over entire continents in seconds."

"Can you satisfactorily carry out visual observation?"

"We received tasks from experts of various fields of science and the economy--geologists, fisherman, agricultural workers, volcanists, geographers--and I haven't named them all! They communicate regularly with us. For example, we're now passing over the Caspian seacoast in the region of the Mangyshlak Penninsula. Dark strips of faults are visible. They extend to the western coast of the Aral Sea, and then turn towards Aktyubinsk. In the Syr Dar'ya region, similar structures are also visible. And then a fault line stretches to Balkhash, skirting the Aral Sea. Such formations are visible only from space. This is why the results of our observations interest the geologists."

"To get to the point, we often recall stories of cosmonauts who have been flying for long periods of time," said Berezovoy. "Success during the conduct of visual observation depends largely on how thoroughly it was prepared for on earth. It seems to me that for Valentin and I, the 'getting accustomed' to Earth went faster and now we already notice much more than during the first days of the flight. In general, we are starting to see that for which we were prepared."

"I would like to add, that this is a specialization. Observing alone, you suddenly see something interesting, and quickly call your partner. We look together, in order to evaluate what we were observing."

"So we, as all cosmonauts, try to look on Earth with the eyes of a scientist," observed Lebedev.

"Are you ready to meet your guests?"

"We'll be glad to accept friends," responded Anatoliy Berezovoy.

"A broad program of scientific experiments has been developed for the Soviet-French expedition," said Valentin Lebedev. "It's a very interesting one. We're convinced that through our joint efforts we will fulfill it completely."

"Tell Volodya Dzhanibekov so that he can master the barbering profession," laughed Berezovoy, "we could use a haircut..."

The days of the space flight...Anatoliy Berezovoy and Valentin Lebedev have already been working in orbit for a month. A resolution of the State Commission, on the results of the first stage of the exploitation of the orbiting complex "Salyut-7/Soyuz", states how the specialists, flight control personnel, and comrades among a host of cosmonauts, evaluate their performance. It says in it, specifically: "Note the high efficiency and initiative of the crew, A. Berezovoy and V. Lebedev."

12198
CSO: 1866/121

MANUAL APPROACH AND DOCKING OF 'SOYUZ T-6' DESCRIBED

Moscow IZVESTIYA in Russian 27 Jun 82 p 5

[Article by Special IZVESTIYA Correspondent B. Konovalov at the Flight Control Center: "Five Men in a Starry Home"]

[Excerpt] Far from our Moscow-area flight control center, in the sky above our planet's southern hemisphere, one of the most crucial stages in the first Soviet-French flight is upon us--the "Soyuz T-6" space ship is approaching the orbiting complex made up of the "Salyut-7" and the "Soyuz T-5". On the large map of the world, occupying the central screen in the Main Control Room, the "Soyuz T-6" is designated by a red dot on its flight path. To catch up with the white "dot", where the "El'brusy"--Anatoliy Berezovoy and Valentin Lebedev--are impatiently awaiting them, the "Pamiry"--Vladimir Dzhanibekov, Aleksandr Ivanchenkov and Jean-Louis Chretien--had to work intensely on 24 June after insertion into orbit and on 25 June. After igniting its engine several times, the "Soyuz T-6" went into its approach orbit. The "Igla" Search and Approach System located the "Salyut-7" and as usual, the distant approach stage proceeded in the automatic mode.

When the space vehicles came within radio range of the ship "Cosmonaut Vladislav Volkov", standing watch in the Atlantic near the West African shores, Lebedev reports: "'Zarya', this is 'El'brus-2', we see the ship on our television screen."

Dzhanibekov's voice is calm when he reports on the status of the "Soyuz T-6" systems.

Valeriy Ryumin, flight director, later told the journalists that the automatic mode had successfully carried out its basic task: it had brought the ship to a distance where the crew could switch over to the manual control of the approach. Flight Control analyzed data from the on-board computer and agreed with the decision by the "Pamiry" to finish the approach in manual mode.

Such variants had been planned for. On the "Soyuz T" ship, the close part of the approach can be accomplished either in a strictly automatic mode, following commands from the on-board computer, or it can be accomplished independently by the cosmonauts themselves. On the "Soyuz T-2", a manual

docking variant was tested, but the other ships in this series use automatic docking.

Suvorov's old principle was once again borne out on this flight: "make training rough, so that combat will be easy." On the morning of 24 June, before the blast-off at Baykonur, Vladimir Dzhanibekov had once again "missed" the opportunity, at the space center's flight trainer, for manual docking at a distance of several kilometers from the station. But now this training stood him in good stead. When the ship and orbital station were 900 meters apart, Dzhanibekov took over the control and gave a demonstration of piloting skill in orbit, as he executed the final stage of the approach and docking more quickly and with less fuel expended than the automatic mode can achieve.

During these moments, the crew takes its bearings from the lights glowing on the "Salyut-7", which had swung around so that its stern docking unit faced the approaching ship. The white flashing beacon on the "Salyut" is visible several kilometers away. When the space vehicles come closer, the red light burning on the left side of the station and the green light on the right side are clearly visible. In the lower part of the "Salyut"'s stern, two vertically positioned white lights are turned on. All of this makes it possible for the commander of "Soyuz T-6" to orient his ship precisely. And a special cross-shaped target, visible in the optical and television systems of the "Soyuz", helps direct the rod of the ship's docking unit exactly into the receiving cone of the station's docking unit.

Dzhanibekov reports: "The crosses coincide!"

Ivanchenkov reports: "The approach is proceeding smoothly".

There is a brief interruption in communications, while the antennas of the ship "Cosmonaut Yuriy Gagarin", operating in the Mediterranean Sea, take over the conversations.

"We have contact!"

The overjoyed voice of the control center's information officer resounds throughout the control room: "We have mechanical gripping". And immediately applause broke out in the Main Control Room.

9887
CSO: 1866/132

SEVENTY-FIVE-DAY MISSION ON 'SALYUT-6'

Moscow ZEMLYA I VSELENNAYA in Russian No 1, Jan-Feb 82 pp 2-7

[Article by S. D. Grishin, doctor of engineering sciences, and A. D. Yegorov, doctor of medical sciences]

[Text] The fifth main mission to the Salyut-6 station was not the longest, but it summed up the space mission of the Salyut-6--Soyuz--Progress orbital complex, which is unique in duration and outstanding in the results obtained.

Cosmonauts V. V. Kovalenok and V. P. Savinykh were participants of the fifth main expedition brought to the Salyut-6 orbital station aboard the Soyuz T-4 manned spacecraft. Soyuz T-4 was launched on 12 March 1981 and it docked with the Salyut-6--Progress-12 orbital complex on 13 March. By this time, the Salyut-6 station had been in orbit for about 3.5 years, and the following had worked there: Yu. V. Romanenko and G. M. Grechko, 12 December 1977 to 16 March 1978; V. V. Kovalenok and A. S. Ivanchenkov, 15 June 1978 to 2 November 1978; V. A. Lyakhov and V. V. Ryumin, 25 February 1979 to 19 August 1979; L. I. Popov and V. V. Ryumin, 9 April 1980 to 11 October 1980, as well as six international crews. Obviously, the crew first made an additional check of the onboard systems and equipment, performed the necessary preventive measures and replaced some instruments and units in order to prolong the station's resources and assure further normal operation thereof (ZEMLYA I VSELENNAYA, 1981, No 3, inside back cover; No 4, pp 2-3, inside back cover --editor). The cosmonauts installed a new unit for directional control of solar batteries, they replaced the pump for removal of condensate in the heat-regulating system, measured parameters of the electric circuits, corrected the flaws they found, overhauled the combined physical training equipment, the "Malachite" unit to be used for biological experiments and one of the television cameras. At the same time, during their first week of intensive work in the orbital station, V. V. Kovalenok and V. P. Savinykh activated the station's systems and unloaded the Progress-12 craft, which undocked from Salyut-6 on 19 March 1981, vacating the "mooring" to receive the international Soviet-Mongolian crew (V. A. Dzhanibekov, Zh. Gurragcha).

As we recall those days, it can be stated that, during the first week of work in the orbital station, the cosmonauts displayed much skill and selflessness, paying no attention to time (V. V. Kovalenok once said that the most unpleasant

aspect of the flight is when you want to rest and know that for about 12 more hours this will be impossible), in performing the big job of preparing the Salyut-6 station for subsequent operations in the manned mode. The stage-by-stage principle of assuring reliability of orbital complex systems and crew safety, adopted in Soviet technology, justified itself completely. It is based on thorough inspection of the station after each mission of the main expedition and meticulous preparation of preventive and repair-overhaul work, as well as replacement of malfunctioning instruments, units and equipment.

The technical experiments aimed at refining orbital complexes and their systems constitute one of the main tasks of space research and experiments.

The "Hologram" experiment became an important technical experiment. In the course thereof, new, more informative holographic methods of recording and transmitting images of objects were tested. Using portable equipment, including a helio-neon laser and recorder, the cosmonauts took holographic pictures of one of the windows, on which remained traces of micrometeorites, as well as of the process of dissolution of table salt crystals in weightlessness. The film with holograms was delivered to earth and is presently being examined in laboratories.

The "Nanovesy" experiment is of great practical importance. It helped determine the effects of the space environment on construction materials. Using precision equipment, the cosmonauts determined the change in mass of silicon dioxide film, which could be used for protecting various optical elements of spacecraft.

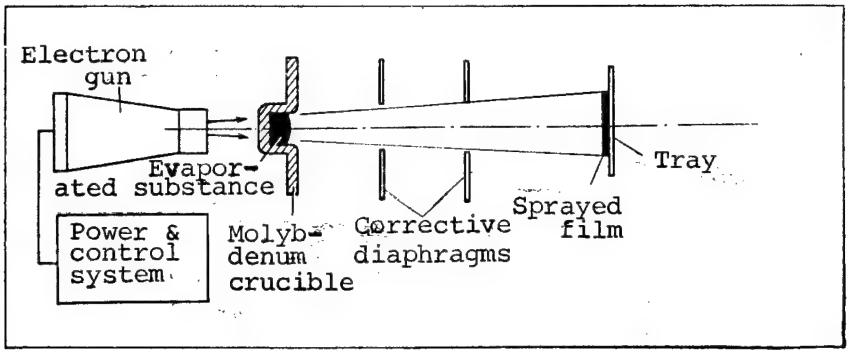
Some interesting new data were obtained in the area of space technology. It has already become routine to produce in orbit, at low accelerations, some semiconductor materials, such as cadmium--mercury--tellurium, indium antimonide, gallium arsenide and others. But during the fifth mission, new technological experiments were also performed using the "Evaporator," "Capillary" and "Pion" units.

The cosmonauts used the "Evaporator" unit for a series of experiments dealing with application of metal coatings by means of evaporation and subsequent condensation in the vacuum of space and weightlessness. They sprayed silver and copper on titanium items both in the sunlit and dark parts of the orbit. The temperature at which spraying was performed varied. As a result of this experiment, the technology for restoring external surfaces of spacecraft in flight was refined and units for such experiments were developed. Scientists who examined the obtained film found that it is of much better quality than that produced on the ground.

The "Capillary" experiment made it possible to obtain monocrystals of a specified profile under microgravity conditions.

The "Pion" unit (an instrument for studying features of weightlessness) was installed aboard the Salyut-6 orbital station and submitted to testing. Its purpose was to make a comprehensive study of processes of heat and mass exchange in liquid media. The "Pion" consists of three main parts: shadow [or shade] instrument with light and movie camera, electronic control unit and working part with changeable trays. The shadow instrument makes visible

areas with insignificant optical heterogeneity. From the pictures obtained, it is not difficult to plot the density field in a liquid or gas medium. If bubbles or solid particles are put into the liquid, one can assess the field of convection current velocities in the tested medium according to their movement.

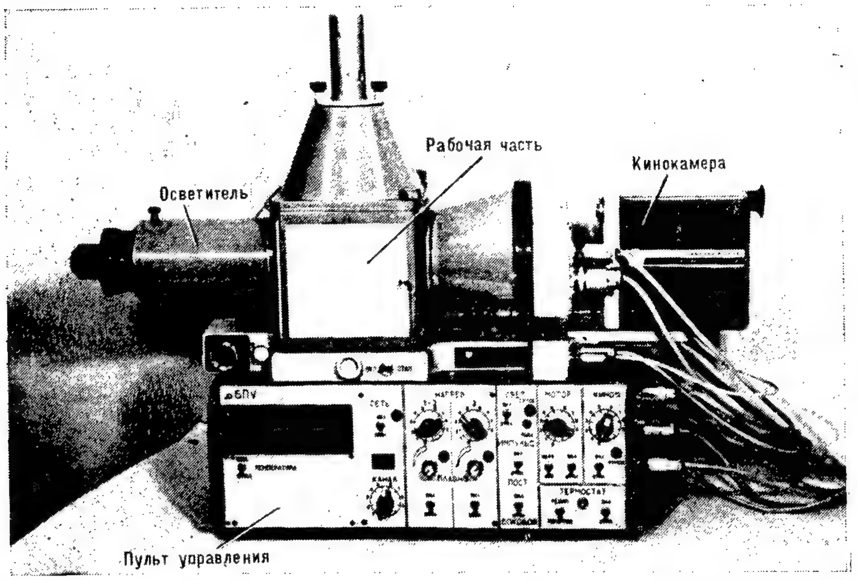


Sketch of "Evaporator" unit

"Drift" and "Convection" experiments were conducted to simulate processes of heat and mass exchange in alloys within cylindrical technological vials. In the "Structure" experiment, studies were made of processes of mass transfer in solution during growth and dissolution of ammonium dihydrophosphate crystal, a substance used in laser technology.

During the fifth main mission aboard the orbital station, two international crews worked: Soviet-Mongolian (V. V. Kovalenok, V. P. Savinykh, V. A. Dzhanibekov and Zh. Gurragcha) and Soviet-Romanian (V. V. Kovalenok, V. P. Savinykh, L. I. Popov and D. Prunariu). The flight programs for the international crews and scientific equipment used are being develoed jointly by scientists of socialist nations who are participants in the "Intercosmos" program. The missions of international crews are of enormous significance to the countries of the socialist alliance, since they are a powerful impetus for development of space research in these countries and an important political factor, which graphically demonstrates further strengthening of friendship and broadening of scientific and technological collaboration of socialist countries. Of course, the research pursued within the framework of the Soviet space program and international "Intercosmos" program are coordinated in such a manner that they yield important mutually supplementary experimental data, which become the property of all socialist nations. The traditional directions of research in the orbital complex are astrophysical experiments, study of natural resources and biomedical research. The program of the fifth main mission was no exception.

The "Astro" experiment, conducted in the space complex by the international Soviet--Romanian crew, was concerned with the study of cosmic rays. The cosmonauts made recordings of partially ionized atoms along the flight course of Salyut-6, as well as high-energy ions, using the Astro-1 and Astro-2 instruments.



Instrument for studying features of weightlessness ("Pion")
Key (clockwise starting at lower left): control console, light, working part, movie camera

Astro-1 was situated in an air-lock chamber, and its detector which consisted of several layers of cellulose nitrate operated like a trap, collecting all particles heavier than helium atoms encountered along the flight course.

The Astro-2 instrument operated within the station. It is assembled from four stationary and four movable detectors, an electromechanical unit and electronic control unit. Incoming particles leave two traces in the stationary and movable detector. The width of the track in the movable detector is known, so that it is possible to determine the latitude at which a particle entered the detector and thereby determine the direction of its travel. These studies supplemented information about the flow of particles that come to us from distant parts of the universe. V. V. Kovalenok and V. P. Savinykh measured submillimeter radiation of earth's atmosphere using a BST-1M submillimeter telescope.

During the first few days of the mission of the Soviet-Mongolian international crew, the scientific program assigned a considerable place to biomedical research for investigation of the distinctions of adaptation to weightlessness. For this purpose, the "Biorhythm," "Questionnaire," "Perception" and "Time" experiments were conducted, in the course of which the well-being and work capacity of cosmonauts and their reactions to flight conditions were studied. In the "Circulation" experiment, determination was made of the effect of

redistribution of blood in the body on the cardiovascular and respiratory systems at the start of the flight. Medical experiments were also conducted during the mission of the Soviet-Romanian international crew. Some of them dealt with determination of optimum modes of using special preventive equipment. In the "Ballisto" and "Neptune" experiments, studies were made of myocardial tonus and properties, changes in acuity and depth of vision of cosmonauts while they were in orbit.

It must be stated that medical problems held a very important place as well during the mission of V. V. Kovalenok and V. P. Savinykh, and in the entire program of long-term flights in the Salyut-6 orbital station.

Examination of V. V. Kovalenok and V. P. Savinykh during and after their 75-day mission revealed that the cosmonauts' physiological reactions to flight conditions were the same as the reactions observed in previous long-term flights, although there were some individual differences. As in the preceding flights, there was the sensation of blood rushing to the head, and one of the cosmonauts presented symptoms that were the same as in seasickness on earth. V. V. Kovalenok adjusted to weightlessness faster and more easily than during his preceding 140-day flight. Throughout the flight, both cosmonauts retained a rather high work capacity. The maximum weight loss constituted 1.4 kg for the commander and 3.6 kg for the flight engineer. The volume of the lower leg decreased. There was insignificant change in the electrocardiogram, as compared to preflight data. The heart rate was in the range of 64-76 beats/min (versus 66-76 beats/min before the flight) in V. V. Kovalenok and 62-76 beats/min (56-62 beats/min preflight) in V. P. Savinykh.

The mission of V. V. Kovalenok and V. P. Savinykh (like other long-term space flights) proved once more that man virtually retains his work capacity in weightlessness, when exposed to it for up to 6 months. This is not associated with any morbid disturbances in man.

Today, we already have an idea about the "average physiological portrait" of a space patient. It is a dynamic portrait, and it depends on the different phases of flight. The motion sickness symptoms and heaviness of the head, which occur at first, disappear by the second week of flight. Appetite and desire to drink remain, although periodically a "negative" attitude develops toward some foods. Usually, the legs become thinner, mainly the lower part, during long-term flights, and there is facial edema during the first week.

Studies of the cardiovascular system revealed that, in weightlessness, there is redistribution of blood filling various parts of the body. With increase in flight duration, this process essentially levels off and becomes stabilized. The body responds to graded physical factors and lower body negative pressure (when a special vacuum device is used) by increasing the heart rate and raising arterial pressure. Still, a clearcut dependence of such reactions on flight duration was not observed. For example, during 75- and 185-day flights, the crews' reactions were stabilized and did not differ from reactions to tests on the ground.

The obvious effects of weightlessness on the muscular system are manifested by some loss of muscle mass, visible atrophy of arm and leg muscles, long and broad muscles of the back, as well as decrease in muscle tone.

Loss of calcium and other minerals of human bone tissue could become a barrier that would drastically limit the duration of space flights. But studies have shown that the decrease in minerals of the calcaneus, even after 6-month flights, was considerably less marked than following long-term bed rest. Apparently, one can also stabilize such an important parameter by means of intensive conditioning of crews.

The results of blood tests are of great scientific interest. It was known that erythrocyte mass decreases after flights. Since the life span of erythrocytes constitutes a mean of 120 days, there should be complete renewal thereof in a 140-180 day flight (ZEMLYA I VSELENNAYA, No 1, 1979, pp 17-21--editor). If weightlessness impaired the process of erythrocyte formation and development severe forms of anemia would occur. The erythrocyte count did indeed decrease, but it was completely restored about 6 months after flights.

The observed changes in erythrocyte structure were rather moderate, and they did not progress with extension of flights. Thus, the obtained data made it possible to assess more precisely the possibility of adaptation of the blood system to long-term space flights and the postflight period.

Thus, the research that was performed failed to demonstrate appreciable functional changes in the main systems of the body that would be a deterrent to further increase in duration of space flights.

Preservation of a good health status and high work capacity during long-term space flights, as well as rather smooth and mild course of the readaptation process following long-term flights, is the result of active preventive measures used during the flights. Such prevention is based on periodic medical check-ups of crews that are performed during the flights. A wise work and rest schedule, proper nutrition, adequate fluid intake and normal duration of sleep were also instrumental in preserving well-being. The course of the readaptation period depends on the scope of preventive measures: the more active the crews were in performing the necessary procedures aboard the craft, the more easily they adapted to earth's conditions.

Research conducted in the interests of various sectors of the national economy occupied a considerable place in the flight program. The main crew of the station and the visiting crews continued to gather information about the mineral and raw material resources of earth, world oceans to examine their biological productivity, fishing and sailing conditions, meteorological conditions in different parts of our planet; they assessed dust and smoke [smog] pollution of the atmosphere and the environment of industrial regions and major cities. The cosmonauts photographed the Aral and Caspian seas, the Caucasus, republics of Central Asia, Southern Urals, southern Siberia and the territory of the Mongolian People's Republic (they examined geological sites, determined water resources and condition of pastures).

V. V. Kovalenok and V. P. Savinykh successfully completed their flight program on 26 May 1981 and returned to earth aboard the Soyuz T-4 descent vehicle.

To sum up the foregoing, it can be stated that the results obtained by scientists and designers (including those obtained during the fifth main mission) proved incontrovertibly that it is possible to create permanent orbital complexes with replaceable crews that will play an outstanding part in development of science and exploration of space and earth's resources for the good of all mankind.

10,657
CSO: 1866/73

PAST AND PRESENT OF COSMONAUT TRAINING CENTER

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 4, Apr 82 pp 40-43

[Interview with Col-Gen Avn (Ret) Nikolay Petrovich Kamanin, Hero of the Soviet Union, and Lt-Gen Avn Vladimir Aleksandrovich Shatalin, twice Hero of the Soviet Union, in January 1982, two months before Kamanin's death, place not specified]

[Text] On 11 March 1982 Nikolay Petrovich Kamanin, famous pilot, prominent Soviet air force leader, and the first teacher of the cosmonauts, passed away. But in January our correspondent had met with Hero of the Soviet Union Col-Gen Avn (Ret) N. Kamanin and twice Hero of the Soviet Union, USSR pilot-cosmonaut, and Lt-Gen Avn V. Shatalov and asked them to answer a series of questions. We publish their conversation below.

[Question] Nikolay Petrovich, the readers of our magazine are interested in the prehistory of the establishment of the Cosmonaut Training Center. Could you please share your recollections?

[Answer] In November 1958 the Council of Chief Designers, which was headed by Sergey Pavlovich Korolev, adopted the decision to develop a plan for a manned spacecraft. The plan was completed by May of the following year, and a commission headed by Academician Mstislav Vsevolodovich Keldysh began defining the requirements for a cosmonaut. The occupation most closely resembling the new one was the occupation of military fighter pilot. And it was at that time that I was called to the Commander of the Air Force, Chief Marshal of Aviation Vershinin.

Comrade Kaminin, he told me, you are being given a new job, a difficult but interesting one. You will work on selection and training of cosmonauts. A cosmonaut training center is to be organized.

After turning over my post as commander of troops for an aviation district in Central Asia I moved to Moscow with my family. That is how a new phase in my life began.

The Cosmonaut Training Center was headed at that time by Yevgeniy Anatol'yevich Karpov, an experienced, energetic leader and major specialist in the field of

aviation medicine. I was the training officer for Soviet cosmonauts for 12 years. But my most vivid memories are probably associated with the first years of my job. And the more time passes, the more clearly you become aware of the importance of the events of those memorable days.

[Question] You were there when the Cosmonaut Training Center was being established. How was it formed, and how did the first training session go?

[Answer] I repeat, it was a new thing, and moreover one of national importance. To meet the challenge in a short time we had to call on all our life experience. But as they say, you will not go far on past experience alone. Therefore, while working to staff the organization, we were also studying ourselves and establishing ties with people who had worked on the problems of the theory and practice of space flight. We wanted their help in determining what to demand of the new candidates. Our circle of acquaintances grew broader with every day. These acquaintances were very useful, for we did not have our own training base. The pilots had to perform their drills at organizations which had trainers for their own purposes. Then, in 1960, the Cosmonaut Training Center was located at the Central Airport not far from the Dinamo metro station. A couple of dozen rooms in two old buildings were hurriedly adapted.

I am sure everyone remembers the first day of training. It was in March 1960. I explained the training program to the pilots. At first they were to study the theoretical disciplines: the foundations of rocket and space technology; the design of the Vostok craft; astronomy; space medicine; and a few other subjects. After four months of training they and their families moved to the construction site of the future Star City [Zvezdnyy Gorodok]. The first medical gear began arriving there in the summer, including Khilov swings, a running track, revolving chairs, and unsupported surfaces. Vestibular research and drills were begun. All the pilots went through tests in anechoic, pressure, and heat chambers and on the centrifuge. They made 40 parachute jumps apiece and became familiar with the catapult. Needless to say, each day they also spent several hours on physical training and sports.

If you wonder about the proportion of each discipline, in the early years the chief ones were probably physical training and biomedical. This is understandable because we were not testing the equipment as much as we were testing the people. We had to determine human capabilities in space flight. That is why medical scientists set the tone in training the first cosmonauts.

[Question] The first detachment of cosmonauts recruited had, as we all know, special characteristics. What were they?

[Answer] To speak figuratively, the path to becoming a cosmonaut can be compared with climbing to the top of a mountain. Anyone can stand at the base, but only the most highly trained, strongest, and most persistent have the strength to climb to the peak. Those were the ones we had to find.

We decided to conduct the selection by stages. The first stage took place in military units. The people selected were above all healthy, devoted to their work, socially active, energetic, seasoned, and without any bad habits. The

main criterion in the second stage of selection was, I would say, perhaps a fanatical desire to fly in new machines. In addition we looked at their physical characteristics. Unfortunately, at this point many worthy candidates were unable to get by the size limitations: not more than 175 centimeters tall and 70 kilograms in weight. After the second round 102 candidates remained. The third stage of selection began in Moscow in the fall of 1959. In March of 1960 only 20 people passed the doctors' test for reserve strength. And in the summer the group of cosmonauts, now known to the entire world, who flew the Vostok craft was formed. Only 12 of the 20 pilots were able to reach the peak of the "space mountain."

At that time we knew very little about the effect of the space environment on the human organism. Even flights with animals could not give doctors complete confidence in a safe outcome. Whereas physiologists were not worried, the psychologists had many doubts. And they were the ones who had the first word. We deliberately adopted the most rigorous requirements: the most reliable people had to be selected. To become a pilot-cosmonaut each candidate had to go through all the tests step by step, one by one. And each step, even the smallest one, was important because it was the only path to the next step.

[Question] Could you please tell us about your first meeting with the space equipment which you and the cosmonauts had to master?

[Answer] I first attended rocket launches at Baykonur in 1960. The launch pad with a rocket ready for launching could not help but inspire respect. It was evidence of the enormous advances of Soviet science and the Soviet economy. On 15 May a rocket was launched carrying a space craft with a load equal to the weight of a human being. This was a technological launch to work out all the systems of the rocket-spacecraft complex. Then in the winter we made an agreement with Korolev for the pilots to train at the plant in an actual ship. A little later came the first meeting with the chief designer. Sergey Pavlovich inspected the pilots in an extremely meticulous way, as if he were calculating whether it would be possible to trust them with his child, with the fruit of the ideas and unselfish labor of many hundreds and thousands of people. The pilots understood the situation, and became very quiet and serious. Sergey Pavlovich smiled, led the men over to the ship, and said: "Today you will begin training in the cabin of the ship. Get used to it. If you have suggestions, don't keep them to yourself. We will discuss them. You are the pilots, and we are working for you."

By the early spring of 1961 the training program for the first group was completed. The pilots passed the test for space flight. The final stage remained: familiarize them with the cosmodrome and give them an idea of preparation of the equipment and the flight itself, even if only from outside.

We flew to Baykonur in March. The heads of the cosmodrome showed the future cosmonauts the scientific-technical complex and tried to instill them with confidence in the reliability of the equipment. On 25 March the next ship was launched carrying Dymka, a cheerful dog that everybody liked. She was renamed "Zvezdochka" through the doings of Yuriy Gagarin. This was a prelude to the origin of the first space call sign.

The launching of the space craft made an enormous impression on all the pilots. Each pilot worked in a definite sector while the rocket was being hoisted. After the launch they had many things to tell one another about what they had seen and heard. But everybody had the same question, "When is our turn?" They did not even suspect that less than one month remained before the first launching of a manned spacecraft.

On 12 April at 0907 Moscow time the Vostok was launched and the era of manned space flight began.

[Question] Vladimir Aleksandrovich, you not only continued the work begun by Nikolay Petrovich, but were a cosmonaut and yourself experienced all the vagaries of the selection. Could you please tell us how you joined the detachment of cosmonauts and the requirements that were imposed on the candidates in your group?

[Answer] When I was enrolled in the detachment of cosmonauts only Yuriy Gagarin and German Titov had been in space. During this time, of course, the requirements for cosmonaut selection could not have undergone major changes. My comrades and I went through the same things as our predecessors. It is true that we had to have higher education. This increased the age of the candidates and limited the number. In addition, our group was figured for the long run, so in addition to pilots we had engineers. One other feature, as we learned later, was that the requirements for the level of vestibular stability were somewhat revised. The medical commission devoted special attention to these matters. After going through all the tests and receiving an okay from the command, we arrived at Zvezdnyy on 11 January 1963.

[Question] What were your first impressions?

[Answer] People at that time thought of space flight as bordering on fantasy, like fairy tales. Of course, we too hoped to see some unusual things at Zvezdnyy. But we understood on the first day that the Training Center was just beginning to be set up. The only living quarters were in the small three-story clinic building, and that is where everyone who was training for space launches lived. The classrooms, dining halls, and recreation room with a billiard table were also there. At supper we became acquainted with the cosmonauts of the first group. And as happens in those situations, after clarifying "who was who" we began to ask the old-timers about space flight, the ship, and the daily schedule.

We were impatient for training to begin. Yuriy Alekseyevich Gagarin gave the introductory lecture. Then we were shown a black sphere covered with sinter. This was the Vostok re-entry vehicle. The first days flew by like minutes.

One day training periods were cancelled because we were to meet with the chief designer. He was almost a myth, and legends were told about him. Our talk with Sergey Pavlovich Korolev was very interesting and instructive. In conclusion he said:

"You will need great flying skill to rendevouz one ship with another there in space, with extreme time pressure and limited fuel supplies, and reliably dock

the ships. You will have to train a great deal and learn to do this on the ground at first, so that up there, in orbit, you work precisely, boldly, and calmly."

He pointed us to the future and showed us the way to achieve our goal.

[Question] Vladimir Aleksandrovich, the preparation of cosmonauts for flights beginning with the Vostok ships took place before your eyes. Space technology has improved rapidly in the last 20 years. How have views concerning cosmonaut training changed in connection with this?

[Answer] It is not just changes in technology, but literally every flight into space brings new results and new experience and poses new problems. This conclusion was confirmed for me after my own space flight. For young readers there is a more recent example, the work of the crews on the Salyut-6 station, which was described in the magazine AVIATSIYA I KOSMONAVTIKA. This problem is fairly complex and multifaceted. Therefore, I will take up only the fundamental, key points in the development of Soviet manned space flight. Two stages can be traced in the period that has passed: the formative stage and practical use in the interest of the national economy. The principal objective of the first phase was to teach human beings and space craft to fly. After this the main objective was to use each flight effectively.

Work at the Center was organized in conformity with this. In the second phase Zvezdnyy began to establish its own basic training facilities. We began moving vigorously outside the Center and entered closer contact with scientific organizations that fabricated scientific equipment and developed methodologies for research work in space. The plan of work changed also. Whereas earlier the process of crew training ended with the trip to the launch pad, now while one crew was working in space training had to be continued for launching others. In this stage we began to set up the scientific research and testing center, which brought together the efforts of many collectives taking part in preparation for space flights.

The technical equipment used to train cosmonauts has been steadily improved. In 1980 we opened the hydrolaboratory, which took the place of the hydrotank. It enables us to simulate crew flight in the Salyut-Soyuz orbiting complex under conditions close to weightlessness. To achieve this the installation-hoisting platform lowers dummies of the ship and station deep under the water and the pressure suit gives the person an unsupported position that is close to weightlessness. In the hydrolaboratory the cosmonauts practice operations of repairing equipment and walking in space. It was here that we modeled and found a solution to the situation that occurred after the unsuccessful jettisoning of the KRT-10 telescope antenna from the docking unit of the Salyut-6. Valeriy Ryumin and Vladimir Lyakhov carried out all the center's recommendations perfectly. The path to the docking assembly was opened for the next ship. This incident allows us to judge the great opportunities offered by close cooperation among the crew, the Flight Control Center, and the Cosmonaut Training Center in connection with new technical equipment.

One of the unique new structures is the centrifuge with an arm about 18 meters long. This makes it possible to create equidirectional loads with change in cabin pressure, humidity, "altitude," and gas composition. During drills here, just as in the hydrolaboratory, all parameters that characterize the organism of the test subject are transmitted to visual and recording devices.

The technical equipment of the center is not only being improved, but also supplemented. Formerly we studied the stars under the open sky, at the Moscow planetarium, and even flew to Africa. Now a planetarium has been built at the center with the aid of East German specialists and in it the stars can be observed from orbiting altitude, that is, it is possible to observe at an angle of 15 degrees to the horizon, which is the case in real flight.

I have only discussed the unique structures. If this were a special topic, the discussion could continue.

[Question] The Cosmonaut Training Center now has adequate facilities to do its job for our country and even to train the citizens of other countries. Are there any special features involved in this.

[Answer] Of course, there are. Judge for yourself. Before space flight even the boldest "forecasters" could not anticipate the entire volume of information that is received from orbit, but today one is sometimes amazed at the knowledge of people who are interested in space problems. The time has come when, regardless of any specific features, the cosmonaut must produce practical benefits for earth. This means that even before the flight into space it is becoming increasingly important for the cosmonauts to have a firm mastery, developed to the point of automatism, of the research and experimental methods of the most diverse fields of knowledge and human activity. Without desiring it the cosmonaut today has become a universalist. In addition to a good knowledge of technology, to say nothing of good health, he must be able to make astrophysical and geophysical measurements, understand geological structures and meteorology, understand processes taking place in the world ocean, and much more. In addition, he must have journalistic talents. It is hardly possible here to list all the things that he must know and be able to do. Incidentally, the daily assignment of the crew of the Salyut-6 station required a sheet of paper 1.5 meters long.

As you can see, many things are now known and clear. But this does not mean at all that we are rid of our problems. We are concerned, for example, with the problem of how to minimize time losses in performance of particular operations. We cannot copy the experience of aviation; you do not send a person into space for an extra trip. Everything has to be studied carefully, tested, and run through many times on the ground.

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'COSMOS' SERIES SATELLITES

Moscow ZEMLYA I VSELENNAYA in Russian No 1, Jan-Feb 82 pp 22-26

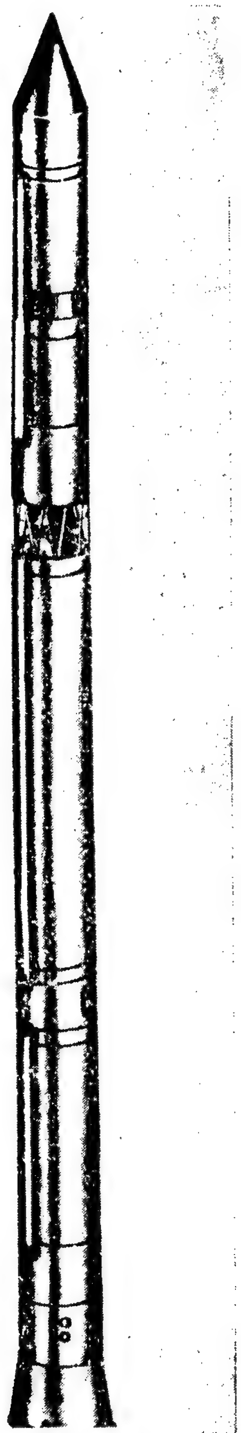
[Article by B. A. Pokrovskiy]

[Text] On 16 March 1982 it will be 20 years from the day that the first artificial earth satellite of the Cosmos series was launched. As of 12 August 1981, 1295 satellites of this series had been launched.

'Ground' and the Cosmos Satellites

By the time the first satellite of the Cosmos series was launched, ground services (or "Ground" as they are sometimes called) had gained considerable experience. They had already implemented successful control of 16 space vehicles, ranging from the world's first artificial earth satellites to unmanned interplanetary stations and manned spacecraft. Nevertheless, the new long-term program for investigation of the top layers of the atmosphere, near-earth space, solar-terrestrial relations and refinement of space technology in orbit made it necessary to improve the equipment of the command and measuring complex, refine methods and means of controlling flights and transmitting information. After all, prior to the missions of the Cosmos series of satellites, the command and measurement complex controlled simultaneously the flights of 1-2 spacecraft. No more than 15-20 radio commands were transmitted on board and a relatively small volume of information was received from the satellites. The results of measuring the orbit were transmitted to the coordinating computer center via telegraph. The telemetry information needed to control flights was processed manually, right at the tracking stations, and telegraphed to the Center. Urgent data were communicated by telephone and "loudspeaker" communication. Film with records of all of the information was delivered to Moscow by aircraft and, in bad weather, on trains and motor vehicles, in "relays" as local jesters quipped. But quite soon the existing state of affairs ceased to be satisfactory.

For this reason, early in 1962, new command and measurement systems were developed and assembled. Their reliability and accuracy were checked by specialists with particular thoroughness. Test engineers made "overflights" of the tracking stations on an Il-14 aircraft, equipped with radio equipment analogous to that subsequently installed on the Cosmos satellites. And



Many satellites of the Cosmos series were inserted in orbit with the two-stage Cosmos carrier rocket

already the launches of the first tens, then hundreds of Cosmos vehicles offered brilliant confirmation of the scientific validation of the engineering of the new command and measurement systems, methods of using them, and they also confirmed the benefit of using them in the future. The systems developed over 20 years ago, after undergoing some updating, are serving the Cosmos satellites faithfully to this day. This made it possible to reduce the expenses for space research and, consequently, improve its effectiveness.

Development and organization of series production of the two-stage Cosmos carrier rocket, which was used to launch many hundreds of satellites, was also instrumental in substantial reduction of expenditures.

Standardization of units and onboard systems of satellites was also economically advantageous, since the continuity of many of the main elements of construction was retained. Standardization affected primarily the frame of the apparatus. The frame consists of three units, each of which is a self-contained module. The first holds the scientific equipment, the second service systems and the third the power sources. If necessary, the scientific [research] equipment can also be placed on the frame of the satellite.

The duration of a flight and nature of research determine the choice of power system, chemical or solar batteries.

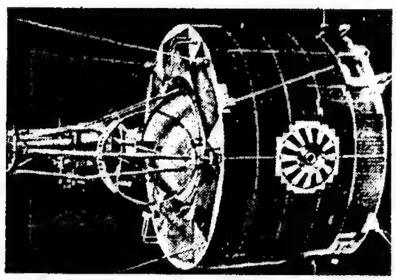
The first modifications of satellites in the Cosmos series (with chemical power source) serve to examine the composition and density of top layers of the atmosphere. In this case, solar batteries are not desirable, since such studies must be pursued in a "clean" environment. But in space, the superficial layer of solar batteries is destroyed under the influence of vacuum and radiation, and the minutest particles, as well as

gas molecules released from construction materials "pollute" the atmosphere (true, this is of course local and very negligible pollution).

Cosmos satellites in the second version are intended for long-term scientific research. In this case, the chemical power sources are replaced with solar batteries.

The third modification of Cosmos series satellites serves for the study of processes occurring on the sun. The satellite is outfitted with systems for orientation (solar) and stabilization.

The geophysical instruments must be oriented toward specific parts of earth's surface. Earth orientation is also needed for studies of atmospheric radiation. In such cases, a fourth version of the Cosmos satellite is used, which has an aerogyroscopic orientation system.

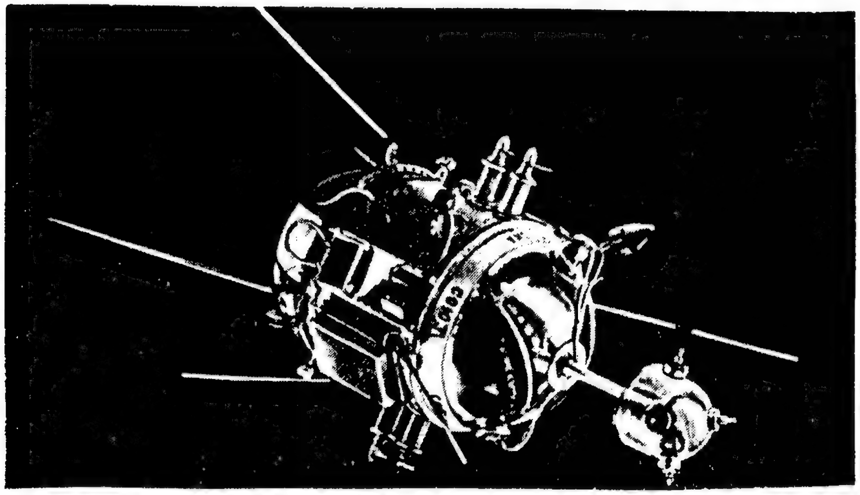


Cosmos-381, aboard which combined studies of the atmosphere were pursued

However, when the experimental conditions require the return to earth of biological objects, scientific material, instruments and specimens, a "landing gear" is used, which is equipped with a descent vehicle (or capsule), powered braking unit and parachute system. Most satellites of the Cosmos series are launched by an individual rocket carrier. But, in a number of cases, one rocket has launched into orbit two Cosmoses, three, five and even eight at a time. This applies, for example to Cosmos-1100, 1101; Cosmos-71, 72, 73, 74, 75; Cosmos-1287, 1288, 1289, 1290, 1291, 1292, 1293, 1294. The duration of operation of these vehicles in near-earth orbits is also different: Cosmos-27 required only 1 day to perform its flight program, whereas Cosmos-1267 has been flying around our planet and working actively for about a year. There are also differences in orbit inclinations of the Cosmoses in relation to earth's equator, ranging from 48 to 82°, as well as in altitude of orbit, from 200 km to several tens of thousands of kilometers.

Information about the operation of onboard equipment and results of scientific research and technical experiments can be transmitted to earth both according to programs in the onboard automatic equipment or by command from the Mission Control Center, depending on the purpose of the launch. Of course, information is received when the satellites pass through regions that are in radio range of ground-based stations of the command and measurement complex. If, however, scientists require information from a Cosmos flying over regions of the USSR

where there are no tracking stations, aircraft with measuring equipment are sent to such places. They can perform their jobs both at the airport and in the air. Expeditionary craft of the USSR Academy of Sciences are also used for communication with Cosmos satellites. If, for example, a descent vehicle (let us say, in Cosmos-782) must be landed on earth, the ships [craft] monitor passage and implementation of the landing cycle commands (orientation, time when power brakes are turned on and off, separation). If scientists from other countries are involved in the experiments, information from Cosmos was also received by ground stations abroad.



Physicochemical parameters of the top atmosphere of earth were studied aboard the Cosmos-108 satellite

As they flow over regions of our planet where there are no tracking facilities in participating countries, the satellites record the readings of scientific equipment in electronic memory and transmit them to earth only when they reappear in the radio range of "their" measuring [check] points. Depending on the flight program, some satellites start to transmit data upon command of onboard time-program equipment and others upon request from the ground. The stationary and mobile measuring units of the command-measuring complex maintain communication over numerous channels with tens of satellites. As they receive radio signals from the satellites, the measuring stations relay them to the computer coordination centers specifically concerned with the mission of a given satellite. There, by means of high-speed universal and specialized computers, the radio signals are translated into numbers, letters, curves and phototelevision images that are understandable to scientists. By interpreting this information, scientists obtained data of enormous scientific importance that has already benefited people in practical respects. Let us recall some of the main directions and results of research and experiments performed on the Cosmos series satellites in two decades.

Ionosphere and Magnetosphere

The ionosphere is constantly subject to changes. Some of them--daily, seasonal--occur regularly while others are periodic, for example, because of powerful solar bursts. Communication personnel have apparently not yet forgotten how radio communication with the ground had been almost entirely disrupted for two hours on 2 September 1967, because of an extremely powerful solar burst. In order to properly select the radio frequency for reliable communication on earth and in space, one must study well the "habits" of the willful ionosphere (ZEMLYA I VSELENNAYA, No 5, 1981, pp 42-46--ed.). Ionoprobes (one of them is Cosmos-381) helped solve this scientifically and practically important problem. Seasonal variations in the ionosphere were studied by means of satellites launched at different times of the year: Cosmos-261 in the winter and Cosmos-348 in the summer.

Satellites of the Cosmos series studied the characteristics of the magnetosphere and processes that cause aurora borealis. In accordance with the program for international studies of the magnetosphere, experiments were conducted in 1976-1979 using Cosmos satellites and a network of ground stations.

Some satellites inserted into polar orbits had to observe magnetosphere-ionosphere interactions. The characteristics of cold ionospheric plasma, electron and proton flux, aurora borealis and radiation belts were measured with equipment aboard Cosmos-900. The first studies already demonstrated that there was a close link between the earth's radiation belts and magnetic storms, aurora borealis and solar activity.

It is interesting to know about the radiation situation in near-earth space from the standpoint of assuring the safety of manned spaceflights. Thus, readings taken by Cosmos-7 made it possible to choose radiation safe orbits for Vostok-3 and Vostok-4, in which A. G. Nikolayev and P. R. Popovich made history's first group flight. Cosmos-4, 5 and 17 recorded additional radiation from the nuclear explosion caused by Americans on the Starfish program. Cosmos-261 and 262 demonstrated complete disappearance of the consequences of this explosion only 7 years later. Corpuscular radiation presents a serious hazard to cosmonauts. Absorbent shields are not usable as protection, since their weight is excessive. For this reason, the study of the behavior of the sun and forecasting safety of manned space flights have acquired practical importance. Cosmos-166 and 230 were launched for this purpose to monitor the sun.

Cosmic Rays

Acceleration of cosmic rays occurs in the interplanetary environment, as well as magnetospheres of earth, Jupiter and, perhaps, other planets. For this reason, information about cosmic rays would help gain deeper understanding of various nonstationary processes occuring both within and without the solar system. There are particles in space the enormous energy of which cannot be produced on earth by the most powerful accelerators.

It is also of great practical importance to study cosmic rays: they affect propagation of radiowaves on earth's biosphere also. The flux of cosmic rays is hazardous to cosmonauts.

Satellites of the Cosmos series were very helpful in learning about cosmic rays. In the experiments, attention was focused on the study of modulation of galactic cosmic rays (which penetrate into the solar system) by solar wind, as well as on measurement of the energy spectrum, charge composition and other characteristics. Cosmos-225, 410, 443, 477 and 555 examined the composition of cosmic rays at 200-300 km above earth's surface.

Extra-atmospheric Astronomy

This area of space research includes measurements over the entire range of the electromagnetic spectrum: radio, infrared, submillimeter, optical, ultraviolet, x-ray and gamma astronomy. It is necessary to take instruments beyond the atmosphere because most astronomic objects emit their main energy in the form of electromagnetic waves that cannot be observed even from the tallest mountain peaks, because of the marked absorption of this radiation by earth's atmosphere (ZEMLYA I VSELENNAYA, No 5, 1977, pp 29-32--ed.). Cosmos-215 was one of the first to "go into" astronomy. The topic of its studies consisted of hot stars in different ranges (from the visible to ultraviolet parts of the spectrum), as well as recording radiation in the spectral region of 0.5 to 5 Å.

A combined experiment to study the spectrum of electromagnetic waves below 3000 Å was conducted in Cosmos-262.

The scintillation spectrometer installed in Cosmos-428 helped detect bursts of hard x-radiation generated beyond the solar system. This is how bursting x-ray sources were discovered.

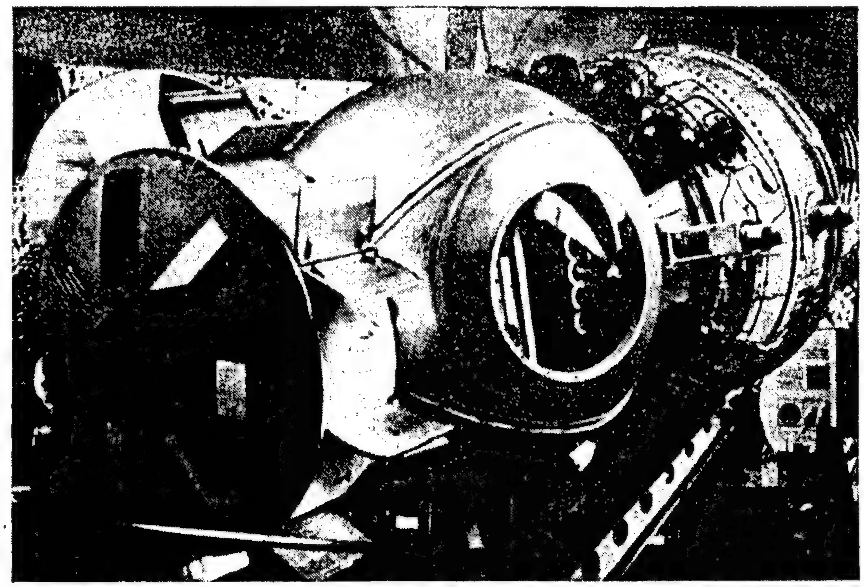
Some very interesting information was obtained with the flight of the first gamma telescope installed on Cosmos-264. Cosmic gamma radiation of photon tracks was measured. The spectrum of background radiation in the hard x-ray range and soft gamma rays was studied by the Cosmos-461 satellite.

Biomedical Experiments

The Cosmos series of satellites made a large contribution to our knowledge about the effects of spaceflight factors on the functional state of biological objects, ranging from unicellular algae, plants and their seeds (Cosmos-92, 94, 109) to dogs and other animals (Cosmos-110, 605, 690, 782, 936, 1283). Biomass was first produced in Cosmos-368. This experiment may play an important part in life support in future long-term manned spaceflights. During the flights of Cosmos-605 and Cosmos-690, studies were made of the mechanism of effects of prolonged weightlessness on processes of organism development. Experimental studies were pursued of a new type of protection against charged particles--the electrostatic type. It consists of generating and fixing near the protected module an electrostatic field that deflects the flux of charged particles. Another type of protection--dielectric--based on deflection of particles by an electric field began to be refined on Cosmos-690.

One of the main directions of research pursued in Cosmos-782 was to study the biological effects of artificial gravity. A centrifuge, 66 cm in diameter, was installed aboard the satellite. Containers with biological objects were

placed on a revolving platform. Some containers were in a zone where accelerations were generated that equaled free-fall acceleration on earth, while others were in a zone where acceleration constituted 0.6 G. Similar objects were also kept in total weightlessness. There was a synchronous experiment in progress on the ground where all flight conditions were present (of course, with the exception of weightlessness). The returnable biological satellite, Cosmos-1129, contributed very much to science. In particular, determination was made of the possibility of fertilization and development of mammalian (white rat) embryos, as well as embryonic development in weightlessness of Japanese quail eggs.



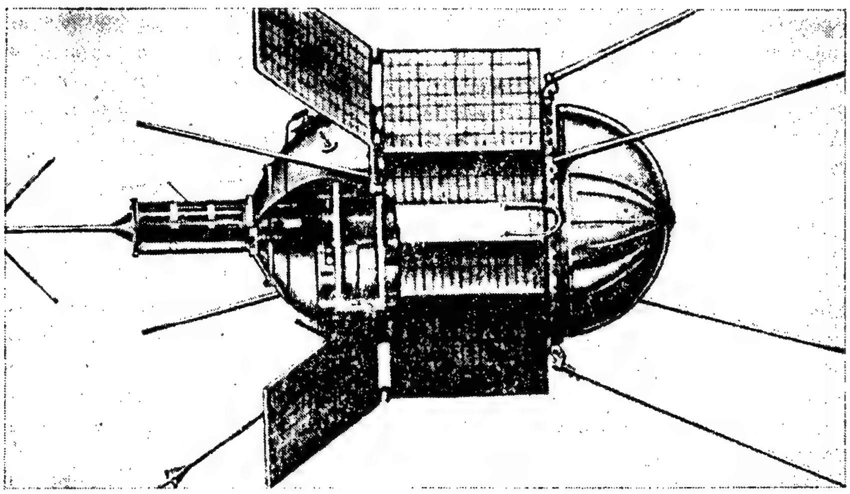
Biological satellite, Cosmos-782. Equipment for keeping animals and other biological objects was situated in the descent vehicle of the satellite

Test Site in Orbit

The Cosmos satellites also became a distinctive scientific test "site" for refinement of elements and entire units of space technology, as well as for experiments that cannot be performed on earth.

First of all, let us recall the entirely automatic docking and undocking, which were brilliantly performed by two "pairs" of satellites, Cosmos-186 and 188, Cosmos-212 and 213. Thus, the Cosmos satellites participated in developing presently existing space installations, such as the long-term Salyut--Soyuz--Progress research complexes. Launching of Cosmos-1267 on 25 April 1981, its automatic docking on 19 June of the same year and prolonged flight together with the Salyut-6 orbital station played an important role in developing future space vehicles and assembling large-sized and heavy orbital complexes.

Refinement of elements of new technology aboard the Cosmos satellites also had a direct influence on development of ground-based command and measuring equipment. Thus, the results of testing of a quantum molecular frequency (time) generator aboard Cosmos-97 was instrumental in improving the accuracy of unified tune apparatus, as well as "sensitivity" of receiving equipment and stability of transmitter radiowave frequency. Experiments with superconductor instruments aboard Cosmos-140 and 213 helped raise appreciably the reliability of equipment on earth and in space.



Molecular quantum generator was tested aboard the Cosmos-97 satellite

Elements of onboard equipment refined in Cosmos-41were used with success in the Molniya relay satellites. The knowhow gained in the course of experiments aboard Cosmos satellites was also quite valuable to development of the Meteor meteorological satellites. Cosmos-243 received thermal radiation from our planet and its atmosphere. This yielded data on the distribution of atmospheric moisture and temperatures in the world oceans, and made it possible to map antarctic ice regions, regardless of whether their limits were covered with clouds or not. Temperatures and optical heterogeneity on the surface of water, turbulence and storms were studied by means of the oceanographic satellites, Cosmos-1076 and 1151, which is very important to meteorology and safety of maritime navigation.

It should be stressed that it is expressly within the framework of the Cosmos program that international practical collaboration of socialist countries started in the area of studying and exploring space for peaceful purposes. Cosmos-261 was the pioneer of joint experiments. Then, in Cosmos-782, 936 and 1129, specialists from CSSR, the United States and France conducted experiments together with Soviet scientists. Specialists of the People's Republic of Bulgaria, Hungarian People's Republic, GDR, Polish People's Republic and

Socialist Republic of Romania participated in the analysis of the obtained experimental data. International collaboration on the Intercosmos program, which was conceived within the framework of the Cosmos program, has yielded some remarkable results.

The Cosmos satellites are starting their third decade of work. As our cosmonautics moves from one important stage to another according to plan, it systematically continues with the study and exploration of space for the good of mankind, for progress and peace on earth. The Cosmos satellites, whose serial numbers now have four digits, are continuing to make their contribution also.

10,657
CSO: 1866/73

UDC 523.165

EFFECT OF DYNAMICS OF STRUCTURAL FORMATIONS IN INTERPLANETARY MEDIUM ON PROPAGATION OF CHARGED PARTICLES GENERATED IN SOLAR FLARES IN 46-85° WEST LONGITUDE IN SEPTEMBER-NOVEMBER 1973

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 1, Jan-Feb 82 (manuscript received 3 Nov 80) pp 73-81

VAKULOV, P. V., VOLOGDIN, N. I., KUZHEVSKIY, B. M., MINEYEV, Yu. V., SPIR'KOVA, Ye. S. and SHESTOPALOV, I. P.

[Abstract] The authors analyze the temporal pattern of the increase in intensity of solar cosmic rays generated by the flares of 7 September, 4 October and 3 November 1973 in the area bounded by 46° and 85° West Longitude. The measurement data used were gathered by the "Prognoz-3" artificial Earth satellite and the "Mars-7" automatic interplanetary station. After discussing each flare in detail, the authors conclude that the behavior of the particles corresponds only partially to the diffusion model, because structural formations in the interplanetary medium that are distinguishable on the basis of interplanetary magnetic field and solar wind parameters have an effect on it, it being the case that they have different effects on particles with different energy levels. Figures 4; references 11: 10 Russian, 1 Western.
[62-11746]

UDC 524.1.732

GAMMA-RAY BURSTS: EXPERIMENTAL DATA INDICATING HELIOSPHERIC ORIGIN

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 1, Jan-Feb 82 (manuscript received 30 Feb 81) pp 89-96

KUZNETSOV, A. V.

[Abstract] The author gives a brief review of what is known about gamma-ray bursts, then turns to the problem of determining their origin(s) on the basis

of 71 observations ranging from 1972 to 1979. Changing from the normal use of galactic coordinates to helioequatorial coordinates, he determines the distribution of the bursts' apparent origin with respect to heliolatitude. The distribution appears to be at least partly symmetrical. Another conclusion he reaches from his analysis of the heliolatitude distribution is that the bursts appear in pairs. A third conclusion is that the bursts have a tendency to propagate in groups, alternating from the southern to the northern hemisphere. The author suggests that there may be some relationship between the bursts and solar coronal holes, which also appear to have a latitudinal dependence, and solar activity cycles. Finally, he says that it is possible that gamma-ray bursts are of heliomagnetospheric origin. Figures 6; references 16: 6 Russian, 10 Western.
[62-11746]

UDC 531.36

PLANE SATELLITE REVOLUTIONS RELATIVE TO CENTER OF MASS IN VICINITY OF COLINEAR LIBRATION POINT

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 1, Jan-Feb 82 (manuscript received 3 Mar 81) pp 145-149

MARKEYEV, A. P. and KRASIL'NIKOV, P. S.

[Abstract] The authors continue previous work on the problem of the relative motion of a satellite with little mass around its center of mass in a periodic orbit near libration point L_2, formulated as a circular, limited three-body problem, but with the additional assumption that the determination of the angular velocity of the orbital coordinate system is accurate. They introduce three right coordinate systems into their investigation and discuss both the general case of the plane motion of a satellite relative to its center of mass and the special case when the satellite is close to being a dynamically symmetrical body. References 6: 4 Russian, 2 Western.
[62-11746]

UDC 533.95

MAGNETIC FIELD OF PLASMA STREAM FLOWING AROUND BLUNTED BODY

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 22, No 1, Jan-Feb 82 (manuscript received 25 Aug 81) pp 1-4

ALIMARIN, S. I. and TVERSKOY, B. A., Nuclear Physics Institute, Moscow State University

[Abstract] The authors present an analytical solution for the magnetic field of a stream of incompressible plasma flowing around a body of a stipulated

configuration, this representing an idealization of the earth's magnetosphere. This is known to be a valid approach because in an early stage in investigation of interaction between the solar wind and the magnetosphere it was made clear that the plasma flow is described well by a purely hydrodynamic model of supersonic flow around a blunted body. However, until now there have been no adequate computations of the magnetic field near the stagnation point and over the entire surface. This is important because the density at the stagnation point becomes equal to zero, the magnetic field is finite and is twice as great as the field behind the shock wave. With these considerations taken into account, an expression is derived for the magnetic field in regions distant from the body around which the flow occurs (two possible cases are examined); a corresponding expression is obtained for the field near the surface of the body; finally, an expression is derived for the magnetic field modulus at the surface. References 9: 4 Russian, 5 Western.
[90-5303]

UDC 523.165

POSSIBLE MODEL OF 11-YEAR MODULATION OF COSMIC RAYS IN LIGHT OF RECENT RADIOASTRONOMICAL DATA

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 22, No 1, Jan-Feb 82 (manuscript received 16 Jun 80) pp 10-14

SHISHOV, V. I., VLASOV, V. I. and CHASHEY, I. V., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] A scheme is proposed which makes it possible to determine the cosmic ray diffusion coefficient on the basis of observations of scintillations of radio sources. A possible mechanism of the 11-year modulation of cosmic rays is presented on the basis of recent radioastronomical data. If a great number of scintillating sources are observed each day it is possible to plot a two-dimensional map of the distribution of scintillation indices and accordingly, the macroscale distribution of density fluctuations in interplanetary space. Such maps were constructed on the basis of observations of about 150 sources in 1975-1976 which show the scintillation index in the range of distances from the sun $0.2 \leq R \leq 1$ a.u. with a resolution ~0.1 a.u., including the high heliolatitudes. For a full description of the motion of particles it is sufficient to know the distribution of the diffusion coefficient and solar wind velocity in the entire heliosphere. The authors demonstrate the possibility of determining the diffusion coefficient in the simplest case of high energy particles for different distances from the sun and at virtually all heliolatitudes. In examining the possible mechanism of 11-year cosmic ray modulation it is concluded that it is associated primarily with high-latitude regions of the solar wind. Radioastronomical data in dicate a dependence of solar wind velocity on heliolatitude; in years of the activity maximum the velocity in the high

latitudes is less than or equal to the velocity in the equatorial regions, whereas in years of the minimum the high-latitude velocity is approximately 1.5 times greater than in the low latitudes. Cosmic ray variations with an 11-year period are far easier to attribute to corresponding changes in the parameters of the high-latitude wind than to variations in low-latitude regions. It definitely appears that it is the high-latitude regions of the heliosphere which are responsible for the 11-year modulation of cosmic rays. Figures 3; references 10: 8 Russian, 2 Western.
[90-5303]

UDC 533.95

STATIONARY MOTION OF SPATIALLY LIMITED BEAM OF HIGH-ENERGY ELECTRONS IN COLD PLASMA

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 22, No 1, Jan-Feb 82 (manuscript received 8 Dec 80) pp 19-22

MAL'TSEV, Yu. P., Polar Geophysical Institute, Kola Affiliate, USSR Academy of Sciences

[Abstract] Evidently the theory of electron injection in experiments such as "Araks" is imperfect because the mechanism of charge neutralization is unclear and there was an unexpected delay in arrival of the beam in the conjugate hemisphere. V. B. Lyatskiy (GEOMAGNETIZM I AERONOMIYA, 21, 378, 1981) evaluated this effect on the assumption that the current of high-energy electrons is compensated at each point by a countercurrent of cold electrons. The author has taken the same line of reasoning as Lyatskiy, but a simpler solution is found. The distribution function is found for a beam of electronssin stationary motion and the electric potential within the beam is determined. After formulating a suitable model for solving these problems a formula is presented for the velocity distribution function for high energy electrons and their concentration, the distribution function is computed and the beam potential is ascertained. In the considered model the neutralization of beam charge occurs at the expense of background electrons, which decrease their concentration. The principal results of the investigation include the derivation of an equilibrium distribution function for a spatially limited electron beam moving through cold collisionless plasma. In the case of a weak beam the distribution function is close to the "one-flow" type. Within the beam the potential is proportional to the energy density of the injected electrons and is inversely proportional to the concentration of background plasma. As the concentration of beam particles tends to the concentration of background electrons the distribution function tends to a two-flow type, beam potential tends to the injection potential and beam velocity tends to zero. Figures 2; references 5: 3 Russian, 2 Western.
[90-5303]

UDC 550.383:550.388.8

INTERRELATIONSHIP OF RING CURRENT, LEAKING ELECTRONS AND AURORAL GLOW IN MORNING SECTOR OF MAGNETOSPHERE ACCORDING TO 'COSMOS-900' ARTIFICIAL EARTH SATELLITE DATA

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 22, No 1, Jan-Feb 82 (manuscript received 10 Dec 80) pp 85-89

DRONOV, A. V., PANASYUK, M. I., SOSNOVETS, E. N., TVERSKAYA, L. V., TULUPOV, V. I. and KHOROSHEVA, O. V., Nuclear Physics Institute, Moscow State University

[Abstract] Data from "Cosmos-900" were used in an in-depth examination of magnetospheric disturbances during the magnetic storm of 1-2 December 1977. It was possible to compare regions of intensive leakage of electrons with auroras and the intensity profiles of protons forming the storm ring current and study their dynamics. The authors describe the changing picture of interrelated phenomena as the storm progressed from its commencement through its main phase to restoration of initial conditions. A series of figures represents these intertwined phenomena. Figure 1a represents conditions prior to storm commencement; Fig. 1d--during the main phase. Figure 2 shows the temporal variation of geomagnetic activity and the examined magnetospheric parameters, including the course of the maximum intensity of ring current protons, leaking electrons and atmospheric glow. Figure 2, like Fig. 1, naturally reveals a substantial difference in the behavior of the considered parameters. Figure 2 also shows the dependence of the latitude of observation of different parameters on storm time: maximum of the emission $\lambda 3914$ A; intensity maximum of leaking electrons; inner edge of proton profile. Figure 3a gives the position of the polar ionospheric current in the morning sector of the magnetosphere; Fig. 3b shows the relative position of the ionospheric current, inner edge of the ring current and region of intense atmospheric glow. The materials reflected in these figures are described and analyzed in detail and give an exceptionally complete picture of the storm. Figures 3; references 8: 4 Russian, 4 Western.
[90-5303]

UDC 523.165

INTEGRAL GENERATION MULTIPLICITIES FOR NEUTRON COMPONENT AND ACCURACY IN COMPUTING SOLAR COSMIC RAY SPECTRUM

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 22, No 1, Jan-Feb 82 (manuscript received 3 Jul 81) pp 125-126

BEDNAZHEVSKIY, V. M. and MIROSHNICHENKO, L. I., Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, USSR Academy of Sciences

[Abstract] In an earlier article (Dorman, L. I., et al., GEOMAGNETIZM I AERONOMIYA, 6, 215, 1966), in the example of a flare in 1956, an attempt

was made to reconstruct the spectrum of solar cosmic rays (SCR) at the atmospheric boundary. The method used requires data on the latitude effect and spectrum of galactic cosmic rays (GCR). The primary GCR spectrum, however, varies during the 11-year solar cycle, especially with $R < 10$ GV. During some cycles the intensity of GCR reveals anomalies probably related to the reversal of poles of the sun's magnetic field. One such anomaly was observed in 1971-1972. During this same period shipboard measurements were made of the latitude effect of the neutron component along the route Kaliningrad-Atlantic Ocean-South Orkneys. These results are presented and analyzed. Then the integral generation multiplicities for the neutron component were computed using the GCR spectrum for the appropriate period and shipboard latitude measurements of the neutron component using the formula $m(R) = [\partial I/\partial R][D(R)]^{-1}$. The computed m(R) values are given. Comparison of the results of computations by different authors reveals considerable discrepancies in m(R). No final conclusions can be drawn concerning the reasons for these discrepancies; possible reasons are discussed. It is concluded that the error in determining the absolute flux of SCR on the basis of surface data is $\gtrsim 50\%$. Comparison of the computed spectra with spectral data obtained by direct measurements of SCR in the region $R < 1$ GV can serve as another test for the accuracy of m(R) computations. Figures 2; references 12: 6 Russian, 6 Western. [90-5303]

UDC 550.383

ENERGY SPECTRUM OF QUASITRAPPED ELECTRONS WITH E $\gtrsim$ 100 MeV DETERMINED FROM DATA COLLECTED BY 'COSMOS-490' ARTIFICIAL EARTH SATELLITE

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 22, No 1, Jan-Feb 82 (manuscript received 21 Jul 81) pp 129-130

BASILOVA, R. N., KOGAN-LASKINA, Ye. I. and PUGACHEVA, G. I., Nuclear Physics Institute, Moscow State University

[Abstract] During certain time intervals the high-energy electron spectrometer carried on the "Cosmos-490" satellite registered predominantly quasitrapped electrons. This article gives the results of measurements of the energy spectrum of these particles and this is compared with the results of the spectrum of albedo electrons measured in this same experiment. It is shown that by using the values of the pitch angles and the computed values of magnetic field strength at the measurement point it is possible to determine the magnetic field strength at which particles with critical pitch angles experience reflection. These field strengths correspond to the minimum altitude at which the particles can enter the instrument and be registered with a stipulated efficiency. Then the two values of the minimum altitude (for the northern and southern hemispheres) are determined and only those periods for which the lesser of the two altitudes is not lower than 80 km are selected. The electron fluxes were determined for two different values of the L parameter. The outlined procedures made it possible to obtain the integral energy spectrum of quasitrapped electrons in the energy range 80-2300 MeV.

The determined spectrum, together with the spectrum of albedo electrons obtained earlier, reveal a good agreement and clarify the general nature of quasitrapped and albedo fluxes of high-energy electrons at altitudes 200-500 km in the equatorial region. Tables 1; references: 5 Russian.
[90-5303]

STABILITY OF LIBRATION POINTS IN PHOTOGRAVITATIONAL RESTRICTED CIRCULAR THREE-BODY PROBLEM

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 2, Mar-Apr 82 (manuscript received 2 Jul 81) pp 196-205

PEREZHOGIN, A. A.

[Abstract] The problem considered here has already been dealt with extensively in the literature, such as: A. L. Kunitsin and A. A. Perezhogin, "On the Stability of Triangular Libration Points of the Photogravitational Restricted Circular Three-Body Problem," CELEST. MECH., Vol 18, p 397, 1978. As formulated, the problem differs from the classical problem in that the nongravitating point also experiences light pressure from the direction of one of the gravitating bodies. The case of a sun-planet-particle system is considered. The analysis reveals that there can be seven equilibrium special solutions, five of which are similar to classical libration points. There can be gyroscopic stabilization of the sixth and seventh libration points (see also the author's communication: "Stability of the Sixth and Seventh Libration Points in the Photogravitational Restricted Circular Three-Body Problem," PIS'MA V ASTRON. ZH., Vol 2, No 9, p 448, 1976). It is further demonstrated that almost everywhere in the gyroscopic stabilization region for these special solutions there is a stability for most of the initial conditions. The same propositions are demonstrated for the triangular libration points. Finally, stability is investigated for all possible third- and fourth-order resonances for which there is deviation from formal stability. Figures 2; references 18: 15 Russian, 3 Western.
[85-5303]

HIGH-ENERGY GAMMA QUANTA ACCORDING TO MEASUREMENTS ON 'COSMOS-856' AND 'COSMOS-914' ARTIFICIAL EARTH SATELLITES

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 2, Mar-Apr 82 (manuscript received 22 Oct 81) pp 227-236

BLOKHINTSEV, I. D., VOLZHENSKAYA, V. A., KALINKIN, L. F. and NAGORNYKH, Yu. I.

[Abstract] The GG-2M gamma quanta spectrometer was carried aboard the "Cosmos-856" and "Cosmos-914" artificial earth satellites. It was designed for investigating the fluxes and spectral forms of gamma quanta with energies from 100 MeV to several GeV in the neighborhood of the galactic equator and

in the high galactic latitudes. A block diagram of this instrument is provided and serves as the basis for a detailed description of structure and functioning of the instrument. It essentially consists of five coaxial detectors: Cerenkov counter with gamma quanta converter, scintillation counter, scintillation shower calorimeter and two anticoincidence scintillation detectors. The Cerenkov counter is outside the satellite; all the others are inside. The gamma quanta without interaction pass through the anticoincidence counters and are registered by a telescope forming electrons and positrons in a lead converter with a thickness of 1 radiation unit. The registry of gamma quanta and charged particles is separated by anticoincidence detectors effectively registering the charged particles. The first anticoincidence counter precludes instrument registry of secondary gamma quanta generated by the charged component of cosmic rays in the skin of the pressurized instrument container. Electrons and positrons formed by gamma quanta, passing through the Cerenkov and scintillation counters, create electron-photon cascades in the scintillation calorimeter, a sandwich of plates of tungsten alloy and a scintillator with a total thickness of more than 8 radiation units. The total ionization losses of cascade electrons in the scintillator make it possible to estimate the energy of a primary gamma quantum. Coincidences and anticoincidences of signals from the detectors are formed; these are listed and interpreted in a table. Calibration procedures are described. The data processing method is outlined and the results of use of materials collected with the GG-2M are illustrated in the example of the integral gamma quanta spectrum from the equatorial galactic region. Figures 2; rables 2; references 8: 6 Russian, 2 Western.
[85-5303]

UDC 551.510.535.2

NEW UPPER ATMOSPHERE EMISSIONS AS CONSEQUENCE OF ANTHROPOGENIC MODIFICATION OF IONOSPHERE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 2, Mar-Apr 82
(manuscript received 27 Jan 81) pp 237-243

KRASOVSKIY, V. I., RAPOPORT, Z. Ts. and SEMENOV, A. I.

[Abstract] This is an in-depth examination of H_2O^+ twilight resonance-fluorescent emissions and associated emissions and structural characteristics of the upper atmosphere. The concentration of water vapor aloft is discussed. There is evidence of the accumulation of large-scale excesses of water vapor in the upper atmosphere which persist for a long time, although such conditions exist only in winter over the high latitudes where there is no prolonged solar illumination dissociating water vapor or where this radiation does not penetrate, that is, everywhere in the mesosphere below 90-100 km. H_2O^+ is continuously destroyed in the F_2 region. Some water vapor can be regenerated in the turbopause by the oxidation of atomic hydrogen penetrating there from the F_2 region as a result of downward diffusion. The injection of water vapor

into the F_2 region can be ensured at a high level only if all the water vapor injected in the mesosphere diffuses upward. Moistening first appears in the D region and only then with some lag do resonance-fluorescent H_2O^+ is localized in the mesosphere. Data on the joint behavior of upper atmosphere emissions give direct information on the electron concentration and related processes in the upper atmosphere and on the decrease in this concentration with large water vapor injections. The temperature decrease associated with moistening of the atmosphere slows the dissipation of atomic hydrogen into space. After analyzing these emissions, the authors examine the related implications of launching of powerful rockets. The ejection of the products of combustion of rocket engines, especially water and hydrogen molecules, greatly disrupts atmospheric structure. Since the number of rocket launchings is constantly increasing, it is only natural that this type of human activity will constantly affect the state of the ionosphere. A first attempt is made at evaluating the effect of such launchings. Figures 4; tables 2; references 18: 7 Russian, 11 Western.
[85-5303]

UDC 550.385.41

DIFFUSE AURORAL ZONE, PART 6: INJECTIONS OF ELECTRONS AND PROTONS IN DAYTIME SECTOR

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 2, Mar-Apr 82 (manuscript received 2 Jul 81) pp 244-263

MULYARCHIK, T. M., GAL'PERIN, Yu. I., GLADYSHEV, V. A., NIKOLAYENKO, L. M., SAUVAUD, J. A., CRASNIER, J. and FELDSTEIN, Y. I.

[Abstract] This is a continuation of an earlier study (J. GEOPHYS. RES., Vol 85, p 5105, 1980) on the use of simultaneous measurements of protons and electrons on the satellite "Aureole-1." The data from this satellite were for altitudes 1500-2000 km for January-February 1972; data for 13 revolutions were processed. A series of figures give examples of the energy spectra of protons and electrons for several transits. Spectra characteristic for different structural regions of the high-latitude magnetosphere were analyzed; these are described in great detail. A synthetic picture of injections of particles in the daytime sector of the oval is presented. Two-dimensional diagrams of injections of particles with different types of energy spectra were constructed in space-time coordinates, separately for protons and electrons. The relationship between regions of injections with different types of energy spectra and fluxes of energies and particles and the structure of the daytime magnetosphere is made clear. The proposed model of injections of charged particles is compared with the results of experiments on other satellites in the daytime sector of the high latitudes. Figures 6; tables 3; references 70: 5 Russian, 65 Western.
[85-5303]

UDC 551.521.8

MODEL COMPUTATIONS OF CONVECTION RATE IN POLAR IONOSPHERE AND MAGNETIC EFFECTS OF LONGITUDINAL CURRENTS AND THEIR COMPARISON WITH RESULTS OF DIRECT EXPERIMENTS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 2, Mar-Apr 82 (manuscript received 4 May 81) pp 264-276

MASEVICH, N. I.

[Abstract] The author has exploited 80 sources in this review. Included in the presentation are the results of computations of the convection rate and magnetic effects of longitudinal electric currents in the polar ionosphere on the basis of the Lyatskiy and Volland models. Data obtained by the "Cosmos-184," "Triad" and ISIS-2 are compared. The comparison indicates that for the most part the Lyatskiy model agrees satisfactorily with available data both at the "morning-evening" meridian and in the region of the daytime cusp. The Volland model with respect to all parameters agrees with experimental data only in the morning-evening region. In the region of the daytime cusp the Lyatskiy model is very close to the Crooker model of convection as a function of the B_y and B_z components relationship. This validates the hypothesis of an antiparallel joining of the lines of force in the funnel-shaped cusp as the main cause of the B_y effect in the pattern of convection and longitudinal currents in the daytime sector of the oval. These and other models are further compared with one another with respect to various phenomena and events in the ionosphere and magnetosphere. Many of the experiments were made at different times and therefore are not strictly comparable. However, the proposed method for the comparison of data on convection and magnetic effects of longitudinal currents can be used effectively when the principal parameters of the model (electric currents, convection, particle fluxes determining ionospheric conductivity) are measured simultaneously. Figures 2; tables 1; references 80: 19 Russian, 61 Western.
[85-5303]

UDC 581.521

FORMING OF FLUXES OF ENERGETIC IONS IN GEOSTATIONARY ORBIT

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 2, Mar-Apr 82 (manuscript received 27 Feb 81) pp 277-288

PANASYUK, M. I.

[Abstract] The article gives an analysis of the spectral characteristics of ions in a geostationary orbit for the purpose of explaining the observed dominant fluxes of heavy ions. In the first section the author reviews the available experimental data on the energy spectra of H, He, C and O ions in a

geostationary orbit and for H ions gives the best possible approximating function describing the H spectrum in the energy range from about 1 keV to several MeV. Since solar cosmic rays can be an important source of radiation belt particles the author also computed the energy dependences of the He/H ratio on the basis of spectral measurements of ions in interplanetary space; the results of these computations are compared with similar computed data for the peripheral region of the magnetosphere. The second part of the article gives a possible interpretation of formation of the ion spectrum in a geostationary orbit and gives a detailed comparison with available experimental data. It is shown that the similarity of the model form of the spectra relative to E/Q (E/Q is energy per charge) is evidence of the existence of processes of transport of plasma layer ions toward the earth in the macroscale quasistationary electric field of the tail of the magnetosphere and the acceleration of more energetic particles, in which the diffusion coefficient must be dependent on E/Q. The integral energy density of heavy ions of solar origin does not exceed about 5%. With an increase in energy the relative content of heavy ions increases and when E is more than hundreds of keV, their contribution to the total energy density becomes dominant. Disturbances of solar cosmic rays cannot be the principal source of averaged ion fluxes with E > 1 MeV in a geostationary orbit. Figures 4; tables 3; references 28: 5 Russian, 23 Western.
[85-5303]

UDC 550.383

INVESTIGATION OF PLASMA MANTLE OF EARTH'S MAGNETOSPHERE, PART 1: DOUBLE STRUCTURE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 2, Mar-Apr 82 (manuscript received 8 Feb 81) pp 289-296

DUBININ, E. M., ZAKHAROV, A. V., PISARENKO, N. F., LUNDIN, R. and HULTQVIST, B.

[Abstract] The "Prognoz-7" satellite carried the "Promiks" instrument for studying the mass and energy composition of magnetospheric plasma. The "Promiks" complex was designed and constructed at the Swedish Geophysical Institute for measuring the energy spectra of electrons and ions and mass and energy analysis of positive ions. The article describes two cases when the vehicle passed through the high-latitude boundary layer of the magnetosphere. In the first case there was a "classical" mantle in which the plasma moved along the magnetic field in an antisolar direction and at the same time was gradually convected within the magnetosphere. In the second case the boundary layer consists of two zones. In the outer mantle adjacent to the magnetopause there no longer is a flow pattern characteristic for the "classical" mantle. Instead, the plasma has a considerable transverse velocity component. With a southerly component of the interplanetary magnetic field (IMF) the electric field in the polar cap is intensified, but the nature of the convection remains as before. The charged particles of the solar wind

penetrating into the polar cusp, being reflected from the mirror points and drifting in crossed fields, will fill the high-latitude region of the magnetosphere adjoining the magnetopause with plasma, forming a "classical" mantle. With a northerly component of the IMF the situation can be somewhat different. New convectional eddies (one or two, depending on the B_y component of the magnetic field) are formed with an opposite direction of circulation. With not very large positive B_z values the additional eddies are localized in the midday region. The convectional pattern remains approximately the same in the remaining part of the polar cap. Some of the plasma, penetrating into the polar cusp, but not in the midday region, drifting first along the auroral oval, can therefore appear in deeper regions of the polar cap and form an inner part of the mantle with an antisolar direction of convection. In the outer part of the mantle adjacent to the magnetopause the electric field is directed from the evening to the morning side. Figures 6; references 7: 5 Russian, 2 Western.
[85-5303]

UDC 581.521

BOUNDARIES OF REGION OF QUASICAPTURE OF EXCESS RADIATION NEAR EQUATOR

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 2, Mar-Apr 82 (manuscript received 2 Apr 80) pp 300-304

BASILOVA, R. N., GUSEV, A. A., KOGAN-LASKINA, Ye. I. and PUGACHEVA, G. I.

[Abstract] At altitudes 200-1000 km there are fluxes of excess rather high-energy particles whose study requires spectral and precise pitch angle investigations for determining their composition, origin and time during which the particles are held in space by the geomagnetic field. Few such measurements have been made. Since pitch angles are not determined in current experiments, it is impossible to ascertain whether these are albedo, trapped or quasitrapped particles. But these species of particles may be of different origin and have different energy spectra and other parameters. They must be registered separately. The authors here examine the regions of space and the pitch angle intervals in which quasitrapped and trapped particles can exist in excess radiation. All particles having mirror points below 60 km are albedo particles. The boundary of capture at a given L-shell is the line of mirror points of quasitrapped particles and albedo particles lies at 60 km. The boundaries of albedo, quasitrapped and trapped particles can be represented through the pitch angles α_{min} (with the minimum field strength B_{min} at at a particular L shell). For the values of the L parameter 0.95, 1.00, 1.05 and 1.10 it was possible to determine the minimum pitch angle values at the top of a line of force which quasitrapped particles may have at these L shells, and for L = 1.12, 1.15, 1.20, 1.25 and 1.30 the minimum pitch angle values of trapped particles. The α_{min} boundary values could be determined for both quasitrapped and trapped particles. It appears that altitudes 30-60 km are the most intense source of albedo particles. The source of quasitrapped particles is evidently the "ends" of the mirror point lines.

Although the flux of quasitrapped particles has a greater lifetime than the albedo flux, its intensity is not greater than the albedo flux. The mirror point lines are lines of an equal flux of particles with pitch angles of 90° at these points. In creating instrumentation for investigating trapped and quasitrapped particles a table given in this article gives the range of pitch angle values which must be taken into account. Figures 4; tables 1; references: 10 Russian.
[85-5303]

UDC 537.525.1

INFLUENCE OF TERMINATOR ON ELECTRIC FIELD AND LONGITUDINAL CURRENTS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 2, Mar-Apr 82 (manuscript received 4 Jun 80) pp 304-308

LYATSKIY, V. B. and MAL'TSEV, Yu. P.

[Abstract] The influence exerted on the system of electric fields and currents by inhomogeneities of ionospheric conductivity and especially the terminator effect has been poorly studied. R. A. Wolf made numerical computations of electric fields and currents in the middle latitudes with allowance for day-night ionospheric inhomogeneity. Later the authors (GEOMAGNETIZM I AERONOMIYA, Vol 14, No 1, 1974) and others demonstrated that the disturbance of Hall conductivity at the terminator results in the drawing of the lines of equivalent ionospheric currents and convection lines toward the morning side. Within the polar cap the lines of the equivalent ionospheric currents and convection currents are clustered near its morning boundary, whereas outside the polar cap they are clustered near its evening boundary. This is the background against which the authors have continued study of the terminator effects on the electric field and longitudinal electric currents. The case considered is essentially as follows: the terminator, passing along the morning-evening meridian, divides the ionosphere into two regions, in each of which conductivity is uniform. The polar cap has the form of a circle of the radius a. Outside the cap there are no longitudinal currents. Within the polar cap the electric field E_0 is uniform and directed from morning to evening. Conductivity of the daytime ionosphere is assumed to be considerably greater than the conductivity of the nighttime ionosphere. The analysis presented on the basis of such a formulation enabled the authors to draw a number of conclusions, among them the following. A potential difference arises between the equator and pole. As a result the polar cap acquires a negative potential relative to the equator. This generates a meridional electric field directed poleward and this gives rise to the rotation of plasma in a direction opposite the earth's rotation. In addition, if there is a homogeneous electric field within the polar cap region this should generate an additional system of longitudinal currents flowing in to the terminator within the polar cap and flowing from the ionosphere at the daytime boundary of the polar cap. Figures 3; references 8: 3 Russian, 5 Western.
[85-5303]

UDC 551.510.535.4

POLAR CUSP VARIATIONS OF $[O^+]/[N^+]$ RATIO WITH GEOMAGNETIC ACTIVITY

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 2, Mar-Apr 82 (manuscript received 17 Mar 81) pp 308-310

VLASOV, M. N., TELEGIN, V. A. and YAICHNIKOV, A. P.

[Abstract] Regular measurements of the concentrations of O^+ and N^+ ions at an altitude of about 900 km in the polar cusp region were made with a mass spectrometer on a "Meteor" satellite at the solar activity minimum of 1976. Among the cusp phenomena observed were the following: the $[O^+]/[N^+]$ ratio increases by more than an order of magnitude with an increase in magnetic activity from $K_p = 0_0$ to $K_p = 5_+$ and in the illuminated cusp with $K_p = 0_0$ the $[O^+]/[N^+]$ ratio is extremely small (~2) and increases to 5 with $K_p = 5_+$. The objective of this article is to explain the observed $[O^+]/[N^+]$ ratio variations. The formulation of complex quantitative models is presently impossible due to inadequate data. Analysis of the available data indicate that with a change in geomagnetic activity in the above-mentioned ranges the variations in the ratio are approximately proportional to the changes in the concentration of O_2 molecules at the altitude of the maximum in the distribution of N^+ ions but the increase in the ratio is slowed as a result of rising of the maximum of the N^+ layer. Together with other data, such as those obtained in an ISIS-2 experiment, this suggests that the $[O^+]/[N^+]$ variations at the 900-km level as a function of K_p at the activity minimum in the unilluminated cusp are largely determined by variations in the flux of leaking electrons, whereas in the illuminated cusp they are determined to a greater degree by variations in the concentration of O_2 molecules responsible for the annihilation of N^+ ions. The authors contend that this explanation confirms the importance of the reaction of O^+ ions with $N(^2D)$ atoms for the photochemistry of N^+ ions in the ionospheric F_2 region. Figures 1; tables 1; references 9: 3 Russian, 6 Western.
[85-5303]

UDC 523.037: 525.7

QUANTITY OF MATTER TRAVERSED BY ALBEDO PARTICLES DURING ASCENT TO GREAT ALTITUDES

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 2, Mar-Apr 82 (manuscript received 7 Dec 81) pp 314-317

KURNOSOVA, L. V., LIDSKIY, V. V., RAZORENOV, L. A. and FRADKIN, M. I.

[Abstract] The authors have ascertained the quantity of matter through which a secondary particle must pass if formed at the altitude h and rising along a helical line to the maximum altitude H at the equator. A dipole

magnetic field is assumed (the center of the dipole coincides with the earth's center). Formulas are derived which make it possible to determine the length of the path traveled by the particle, this in turn leading to derivation of a formula for ascertaining the quantity of matter through which the particle passes in rising from the initial to the final point. This complex formula is then simplified. A table gives the quantities of matter ΔM g·cm^{-2} through which a particle generated at the altitude h_1 (with the pitch angle $\theta°$) passes in reaching the maximum altitude H = 200 km at the equator. The data were obtained by numerical integration of the complex formula. Then a table is given with the corresponding values obtained using the simplified formula. For example, in the case of formation of a particle with the pitch angle 90° only beginning with an altitude of the formation point $h_1 \geqslant 80$ km can the quantity of matter through which the particle passes be considered insignificant. This is important in examining the motion of particles in circumterrestrial space and examining the possibility of capture of particles in drift motion with repeated passage from one hemisphere to the other. Tables 2; references: 1 Russian.
[85-5303]

SURFACE OF VENUS

Moscow ZEMLYA I VSELENNAYA in Russian No 1, Jan-Feb 82 pp 16-19

[Article by L. V. Ksanfomaliti, doctor of physicomathematical sciences]

[Text] There are "blank spots" left on the map of Venus only near the poles. The features of its topography are indicative of substantial differences between Venus and earth, which are two neigboring planets with virtually the same mass and density, with regard to geological history.

Relief of Venus

It was finally possible to see the surface of Venus, which was always concealed by a layer of clouds and dense atmosphere, in October 1975. The two panoramas transmitted by the Soviet unmanned stations, Venus-9 and Venus-10, are the only direct pictures of the surface of this planet (ZEMLYA I VSELENNAYA, No 3, 1976, pp 3-15--ed.).

For 20 years, the topography of Venus was studied only by ground-based radar (see article by G. M. Petrov elsewhere in this issue). But recently, a new stride was made in learning about Venus. Radar equipment aboard the Pioneer Venus spacecraft, an artificial satellite of Venus, examined the relief of this planet (with the exception of polar regions). Details covering a cross section of about 100 km and, in equatorial regions, about 30 km could be discerned on radar images. Several fragments and variants of maps and the globe of Venus have been plotted.

There are mountains, plains and lowlands on Venus, like on earth. By analogy to earth, the Venusian mountain regions can be called continents. Such mountain regions occupy 8% of the planet's surface, and the largest of them are Aphrodite Terra, Ishtar Terra and the Beta region.

The lowlands [depressions] occupy about 27% of the surface of Venus. They are concentrated in two intersecting belts, the outlines of which resemble the letter, "X." One arc-shaped belt extending over almost 8000 km surrounds the Beta region. The other vast lowland region on Venus was named Atlantis. It is a lunar-type sea, about 2500 km in diameter. It is 2 km lower than the surrounding area.

The rest of the surface of Venus consists of undulating plains. Numerous mountain chains, 1.5-2 km high, about 1000 km apart from one another, are encountered in the northeastern part of Aphrodite, south of the Atlantis plain.

The surface of Venus is situated mainly at the level of a radius of 6051.5 km, while earth's surface is at radiuses of 6371.5 and 6366 km. This difference can only be partially attributed to the "weight" of earth's oceans, which cause insignificant lowering of the ocean floor.

Traces of tectonic activity have been discovered on Venus, as on earth. A large rift system (Artemis Chasma [canyon]) with a dual mountain ridge resembling the mid-ocean ridges on earth was discovered at the southeastern tip of Aphrodite. Another plain on Venus has the same profile and features as the South African rift on earth (ZEMLYA I VSELENNAYA, No 5, 1974, pp 28-33--ed.). The "youth" of some details of its relief are indicative of the tectonic activity on Venus. For example, the slopes of the extensive Northern Plateau in Ishtar, which rises 3-5 km above the surrounding area, resemble the slopes of young mountains on earth covered with disintegrated material. The largest tectonic features on the surface of Venus are similar to shield volcanoes on earth.

Interestingly enough, no analogues were found on the Venus plains of mid-ocean ridges, whereas on the periphery of the continents no zones of subduction were discovered, i.e., places where the lithospheric plates come close to one another, creep over one another and one of the plates submerges in the mantle (ZEMLYA I VSELENNAYA, No 5, 1974, pp 20-27--ed.). In general, the lineaments (large linear zones of tectonic disturbances) on Venus do not join into an appreciable global system. Apparently, there is less tectonic activity on Venus than on earth.

H. Masursky, head of the Astrogeological Department of the U. S. Geological Service, believes that most of the crust of Venus is very old. Perhaps the Venusian crust is notable for stability, whereas earth lost its ancient crust in the course of processing it. H. Masursky believes that "an ancient crust, large volcanic features and tectonically active zones developed on Venus. Venus and earth do not differ any less in their geological history than in their atmospheres."

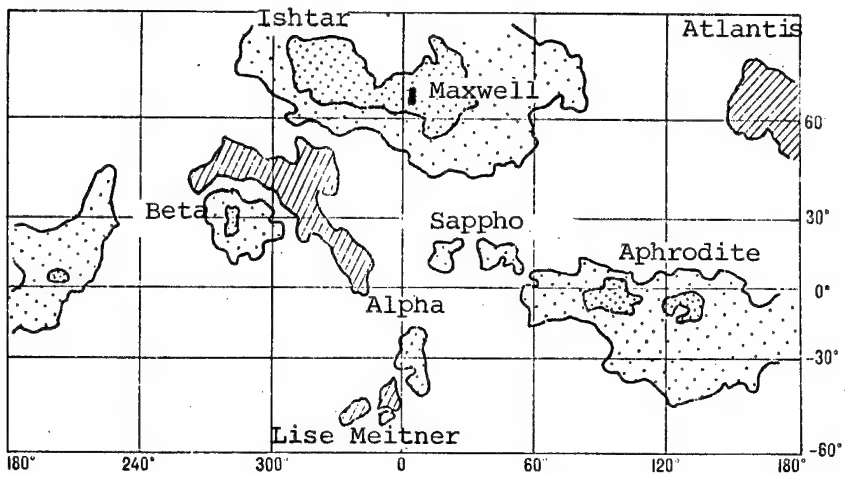
Remarkable Landscape Features

The first features on Venus that became known to scientists are the Alpha and Beta regions. Alpha is a plateau that is over 1000 km in size and up to 2.5 km in altitude, with a rather significant depression in the middle. The zero meridian was drawn through the center of this region. At present, its position has been defined: the meridian is "tied" to a small crater.

There is a crater 300 km in diameter and about 1 km deep southwest of the Alpha region, with coordinates of 55° south latitude and 320° east longitude. Most probably it is an impact crater. It was named Lise Meitner after the famous Austrian physicist who worked in the field of radioactivity.

The Sappho elevation (coordinates of center: 15° north latitude, 15° east longitude), with a cross section of about 300 km, is northeast of Alpha. Evidently, this elevation is of volcanic origin.

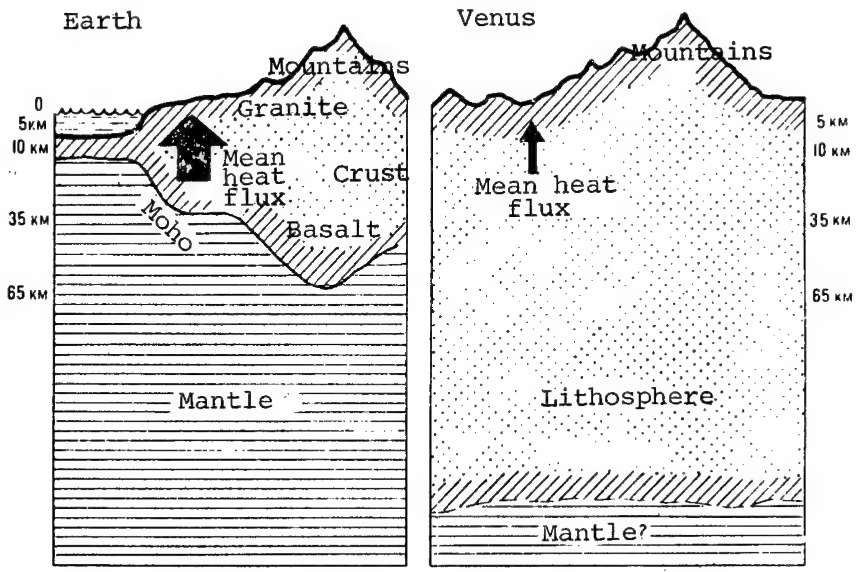
It is assumed that about half of all the ring features on Venus are volcanic mountains. Numerous bright ring features, occasionally with a prominent spot in the center, are situated in Aphrodite. The depth of these craters is small, only hundreds of meters. Artemis Chasma intersects the southern edge of Aphrodite; the diameter of this canyon is about 2600 km (coordinates of center: 35° south latitude, 135° east longitude). Its double wall is markedly destroyed, and a spot that is bright in radio beams is observed in its center. There are the most varied opinions as to the nature of Artemis Chasma. Some consider it to be an enormous crater-phantom, other believe that Artemis Canyon is an analogue of terrestrial island arcs (ZEMLYA I VSELENNAYA, No 3, 1979, pp 30-33--ed.). There is a deep and extensive plain in the eastern part of Aphrodite Terra, which was discovered several years ago during ground-based radar observation of the planet.



Relief of Venus

The highest mountain range on Venus is Maxwell Montes (coordinates: 63° north latitude, 5° east longitude). They are 8 km higher than the surrounding plateau, which was named Ishtar Terra, and 12-13 km taller than the deepest depressions on Venus. The Maxwell range is twice the size of Tibet. According to radar data, the slopes of Maxwell constitute an average of 6°. There is a 100-km caldera at the peak of the tallest mountain, and it is surrounded by ring fracture lines. Most probably the Maxwell mountains are of volcanic origin.

The Ishtar continent is similar in size to Australia. On the radio-albedo map, the surface of the Northern Plateua consists of numerous large, heterogeneous granulations, and the altitude gradient there does not exceed 1 km. The wall surrounding this plateau has distinctive radioreflective properties: such reflection is produced by rock fragments 10 cm or larger in size. Similar rock waste is seen on the panorama transmitted by Venera-9 [Venus-9]. There are elongated recesses [scarps] extending from the south and southeast of Ishtar. It is not yet known what tectonic processes led to formation of this enormous plateau and vast mountain range on it.



Drawing of earth's crust (on the left) and hypothetical structure of crust of Venus (on the right). The structure of the Venusian crust could appear like this if there is low heat flux in its lithosphere

On detailed radar maps, the Beta region (coordinates of center: 30° north latitude, 283° east longitude) appears as a bright spot with numerous streaks diverging from it. It is assumed that this region is similar to terrestrial shield volcanoes with solidified lava flows. A large caldera is seen in the center of the image. The Beta region, with a cross section of about 800 km, is divided into two parts. The northern one was named Rhea and the southern, Theia. The altitude of the entire region is 4-5 km above the foothills. Venera-9 and Venera-10 descended on the eastern slope of Beta. And, although radar yields moderate estimates of the slopes of this region, the panoramas of Venera-9 are indicative of considerable steepness, up to 30°.

The volcanic origin of the Beta region is also confirmed by the fact that perturbations of the gravitational field of up to 60 mgal have been recorded over this region. On earth, similar anomalies of the gravitational field are encountered over young (but not necessarily active) volcanoes.

There are two extensive lowlands with a cross section of about 700 km north of the Lise Meitner crater. Their radio albedo is almost the same as for a mirror-smooth surface. The surface of the lowlands differs noticeably from the surrounding relief. It is smooth, at least on the radiowave scale.

Why Do the Mountain Masses Not "Sink"?

Specialists will probably require considerable time to determine "what's what" on Venus. The presence of tall mountains on its surface appeared doubtful only recently. Indeed, the material of which is composed the Venusian crust

is similar to basaltoids. This is indicated by measurements taken on the surface of the planet with instruments of the Venera [Venus] series and analysis of topography: it is assumed that the parts of the planet's crust that have no meteorite craters are made up of relatively recent ["young"] basaltoids. Proceeding from the isostasy principle (ZEMLYA I VSELENNAYA, No 3, 1970, pp 26-31--ed.), the high mountains with roots of low-density material, for example, basalt, should float on a heavier mantle. But the temperature of the surface of Venus is close to that of earth's crust at a depth of about 15 km. If deep below the surface of Venus the temperature gradient is the same as in the depths of earth, the basalt should soften at the depth of the roots of Venusian mountain masses. It would seem that tall mountains should "sink" into the planet's lithosphere within a brief time. But this does not happen. How do we explain such a miracle?

A hypothesis can be advanced that would explain rather simply the firmness of the Venusian lithosphere, as well as limited tectonic movements on this planet. Let us assume that the material of the lithosphere, the burden on it, its heat conduction and temperature are known. What should be done for the crust to withstand the pressure of the mountain masses? From the engineering point of view the answer is obvious: one must increase the thickness of the arch of the lithosphere, in other words, one must shift "down" the level at which the crust becomes soft. For this, inevitably a decrease in temperature gradient in the lithosphere will be required which, in turn, will lead to a decrease (and a significant one at that) in heat flux from the bowels of the planet. Then the hard lithosphere will be very thick and temperature in depth will rise slowly, while the mountains will stand firmly on the surface, like a house on rocky ground. Moreover, if the heat flux from the depths of Venus is substantially lower than on earth (1.5 $\mu cal/cm^2 \cdot s$), there should be minimal convection in the mantle and its tectonic manifestations should be limited.

There are difficulties with the expounded hypothesis. In the first place, there are no noticeable gravitational anomalies over the mountains of Venus. This is apparently in contradiction to the assumption that the lithosphere is thick and hard. But, perhaps, compensation takes place over a very long period of time. Let us say that the older Maxwell range is already compensated, but Beta is not yet.

And now something about the heat flux traversing the planet's lithosphere. A significant part of the heat that today passes through earth's lithosphere appeared at the early stage of its history. The dissemination of heat from the depths to the surface is a very slow process, comparable to the age of the planet itself. As it passes through the lithosphere, the flow of heat creates a temperature gradient, which is determined by heat conductivity of the lithosphere. The low temperature gradient in the Venusian lithosphere should mean that, for some reason, it either lost its supply of heat at an early stage, or else had an appreciably smaller supply than earth. Decay of radioactive elements scattered in the lithosphere, mainly uranium, thorium and potassium-40, are another source of heat flux. Measurements taken with the Venera series of instruments revealed that these elements are contained in the Venusian crust. Incidentally, some specialists believe that there may be little potassium-40

on the planet, and then the flux from radioactive decay would indeed be minimal. In such a case, Venus should have a thick crust and low tectonic activity.

Interestingly enough one of the prominent Soviet specialists on internal structure of planets, V. N. Zharkov, doctor of physicomathematical sciences, believes that the crust of Venus is thick for the express reason that there are weak tectonic processes on the planet.

Thus, there are many questions. How did the ancient crust and tall mountains persist on that planet, are there active volcanoes? And it appears that the answers to these questions do not lie on the surface, either literally or figuratively.

10,657
CSO: 1866/73

'SIGMA-2' CHROMATOGRAPH DATA ON VENUS'S ATMOSPHERE

Moscow PRAVDA in Russian 4 Jun 82 p 2

[Article by L. Mukhin, laboratory chief, Institute of Space Research, USSR Academy of Sciences, scientific leader of the experiment, doctor of physical and mathematical sciences, and V. Gel'man, candidate of technical sciences: "Let's Hunt for Impurities"]

[Text] During the planning of the programs for studying the planets of the Solar System, special attention is given to the study of the chemical composition of their atmospheres. This is an interesting subject not only because it carries traces of the atmosphere's interaction with the planet's solid shell, but also because it largely determines the planet's climate. For example, a change in the concentration of even such a minor admixture in the Earth's atmosphere as carbon dioxide--its content is only 0.03 percent--has a noticeable effect on the average temperature of our planet's air. Another minor admixture in the Earth's air ocean is water vapor. However, it is this admixture that determines the state of the Earth's cloud cover.

Venus, our neighbor in the Solar System, is also covered with clouds, but there they occur in significantly thicker layers. It is clear that the "responsibility" for their formation lies with some compounds that can condense and form drops of liquid in the atmosphere at altitudes of about 40-70 kilometers above the surface. But just what compounds are they?

There have been very many hypotheses. The possible "candidates" have included water, mercuric chloride, ferric chloride, ammonium chloride and simply dust from Venus's surface. For various reasons, however, as time passed all of these substances had to be rejected, although ferric chloride or ammonium chloride still remain "under suspicion." Most specialists now lean toward the conclusion that Venus's clouds consist of drops of sulfuric acid.

But how do they form? And do the clouds consist only of sulfuric acid? What molecules participate in the formation of the drops? We do not have the final answer to these questions. Only a detailed analysis of the content of minor impurities in the atmosphere will enable us to clarify the picture. In a word, the proverb "little bodies may have great souls" applies here.

In addition to this, on the basis of the content of minor admixtures of volatile elements (such as sulfur and chlorine) it is possible to form an opinion about the

mineral composition of the planet's surface and the content of these elements in its crust. Finally, a comparative study of the atmospheres of the planets in the terrestrial group makes it possible to understand both the general regularities of their formation and development and the differences in their "biographies."

Considering the scientific importance of all these problems, instruments for fine chemical analysis--including "Sigma" gas chromatographs--were installed in the Soviet "Venera-11" and "Venera-12" space stations in 1978.

The first experiments have already produced very interesting results. Among the other components, the gas chromatograph on the "Venera-12" detected the presence in Venus's atmosphere of sulfur dioxide. This gas typically has a volcanic origin.

And so, are there volcanoes on Venus? If this were the case, however, there would have to be other minor admixtures in Venus's atmosphere that are typical of volcanic eruptions, such as hydrogen sulfide. Thus, the "hunt" for minor admixtures was continued.

For this reason, "Sigma-2" chromatographs were installed in the "Venera-13" and "Venera-14" stations. These instruments were developed by VNIIkhrom [possibly All-Union Scientific Research Institute of Chromatography], the Ministry of Instrument Building, Automation Equipment and Control Systems' VNIIKAneftegaz [All-Union Scientific Research, Planning and Design Institute of Complex Automation in the Petroleum and Gas Industry] and the USSR Academy of Sciences' Institute of Space Research, and were improved considerably in comparison with their predecessors. This increased their sensitivity and reliability when determining the content of such important substances as oxygen and compounds containing chlorine and sulfur. A capability for collecting samples at low pressure in the upper layers of Venus's atmosphere--where the still mystifying clouds are located--was provided.

The main feature of the instrument is the use in it of two highly sensitive ionization detectors operating on different principles. Although the general-purpose neon detector had already measured the concentrations of admixtures of argon, carbon monoxide and other substances, this was the first time the new electron-capture detector had encountered Venus's atmosphere. It is particularly sensitive to electrically negative substances, which expands its analytical capabilities considerably. It should be mentioned here that the chromatograph, with its set of highly sensitive general-purpose and selective detectors, was used in a space experiment for the first time ever.

Of course, it proved to be very difficult to build this instrument. The conditions of the space experiment required that it be small and, at the same time, reliable under the most complicated operating conditions. Besides this, it had to "know how" to check its own fitness for operation and differentiate gasses collected from Venus's atmosphere from substances of terrestrial origin that were in the instrument compartment of the station's descent vehicle. The designers of the "Sigma-2" chromatographs solved these problems successfully. In all, about 15 analyses of atmospheric samples (including some from the cloud layer) were made with their help in the "Venera-13" and "Venera-14" descent vehicles.

An analysis of the chromatograms that were obtained shows that along with the previously detected nitrogen, argon, sulfur dioxide and carbon monoxide, there was also

hydrogen sulfide, carbon oxysulfide, krypton, oxygen and other substances. It is fully possible that the data obtained will largely compel us to reconsider our existing ideas about Venus's atmosphere.

Of course, a full interpretation of the information obtained will require a lot of painstaking work on the part of specialists. It is necessary to analyze the conditions the chromatographs encountered on Venus, carry out experimental modeling of these conditions, and reproduce the chromatograms of Venus's atmosphere in terrestrial laboratories. Mathematical information processing methods will be of great assistance. Ahead of us lies much complicated and interesting work, but it is already clear that the use of gas chromatography in space research has justified itself from both the scientific and technical viewpoints.

11746
CSO: 1866/108

UDC 621.371:523.4

POSSIBILITY OF EXISTENCE OF GLOBAL ELECTROMAGNETIC RESONANCES ON SOLAR SYSTEM PLANETS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 1, Jan-Feb 82 (manuscript received 7 Jul 80) pp 82-88

NIKOLAYENKO, A. P. and RABINOVICH, L. M.

[Abstract] The authors discuss the possible parameters of global resonance phenomena on the planets of the Solar System, using the frequency bands from several to tens of hertz and several kilohertz. Resonance phenomena can be observed only when there is planetary storm activity, which limits the discussion in this article to Venus and Jupiter, with Mars and Io being mentioned as possible objects of future study. The authors concentrate on Venus, since its atmosphere has been studied better in comparison with Jupiter's. They reach no final conclusion about the existence of a global resonator on Venus, but state that this is only the result of a lack of observational data. Figures 4; references 15: 10 Russian, 5 Western.
[62-11746]

UDC 621.317:523.42

QUESTION OF MAGNETIC BARRIER NEAR VENUS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 1, Jan-Feb 82 (manuscript received 29 Jan 81) pp 97-103

PIVOVAROV, V. G., YERKAYEV, N. V., VOLOKITIN, A. S., BREUS, T. K. and IVANOVA, S. V.

[Abstract] Since Venus apparently has no magnetic field of its own, so that the solar wind interacts directly with the ionosphere to form a "magnetic barrier" that slows the wind down, the authors use mathematical models of the flow of plasma around solid bodies as a basis for an analytical description of Venus's magnetic barrier and then compare its theoretical characteristics with experimental data; the two match quite well. Figures 3; references 15: 8 Russian, 7 Western.
[62-11746]

UDC 535.24:523.42

SUBCLOUD AEROSOL IN VENUS'S ATMOSPHERE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 1, Jan-Feb 82 (manuscript received 2 Jul 81) pp 104-110

GOLOVIN, Yu. M. and USTINOV, Ye. A.

[Abstract] A finely dispersed subcloud aerosol has been detected in Venus's atmosphere, with its basic light attenuation effect being manifested at altitudes of 32-48 km, although it is also known to exist down to an altitude of 10 km. The authors attempt to make a first-approximation determination of the aerosol's parameters on the basis of spectrophotometric measurements made by the descent modules of "Venera-9, -10, -11, -12." Their conclusions are: 1) the size of the particles appears to decrease as the altitude does; 2) the refractive index cannot be determined with any degree of reliability; 3) the coefficient of extinction decreases as the altitude does; 4) the concentration of particles ranges from 6,400 to 9,260 cm^{-3}, with accuracy of an order of magnitude, at an altitude of 35 km; 5) the relative mass content of the aerosol at an altitude of 35 km ranges from $0.2 \cdot 10^{-8}$ to $1.16 \cdot 10^{-8}$ g/cm^3. They also reach some tentative conclusions about the aerosol's chemical composition. Figures 9; references 12: 10 Russian, 2 Western.
[62-11746]

UDC 629.7.015.7

ONE POSSIBLE DESIGN FOR FLYING VEHICLE IN VENUS'S ATMOSPHERE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 1, Jan-Feb 82 (manuscript received 18 Jun 81) pp 128-139

LINKIN, V. M., MOSKALENKO, G. M. and SKURIDIN, G. A.

[Abstract] The authors discuss the possibility of using the external temperature gradients in Venus's atmosphere as the energy source for a propulsion device, in a manner analogous to the idea of the "solar sail," using substances that are liquids under normal terrestrial conditions to create the aerostatic force for a flying vehicle. After discussing various possibilities and proposing a design for a mobile (flying) scientific research station and listing the problems that could be solved with it, they conclude: 1) because of the special features of Venus's atmosphere, liquids such as water and ammonia can provide more lift than light gasses such as helium and hydrogen; 2) less working body is needed for lift and more for descent, which is the inverse of the situation with the light gasses; 3) the pressure gradient needed to regulate the aerostatic force contradicts the condition of a light and strong aerostatic shell; 4) the idea of a flying vehicle that can function in Venus's atmosphere is a feasible one. Figures 7; references 11.
[62-11746]

UDC 523.042:523.42

ATOMIC OXYGEN IN UPPER VENUSIAN ATMOSPHERE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 2, Mar-Apr 82 (manuscript received 7 Dec 81) pp 312-314

SHOLOKHOV, V. S. and BURGIN, M. S.

[Abstract] The density of atomic oxygen in the upper atmosphere of Venus is estimated on teh basis of a comparison of measurements of total emission intensity in the lines of the triplet 0 I 1304 A and the results of theoretical computations. The experimental data were obtained with the diffraction UV multichannel spectrometer carried aboard the "Venera-11" and "Venera-12." The system of three integral equations corresponding to radiation transfer in the lines 1302, 1304, 1306 A can be reduced to a single equation. In solving this equation it was assumed that the atmosphere is plane-parallel and that there is a Doppler profile of the absorption line which during scattering experiences total frequency redistribution. In addition to line scattering, allowance was made for absorption in the continuous spectrum caused by CO_2. The plane-parallel atmosphere approximation was deemed to be adequately precise, at least distant from the limb and terminator. Two mechanisms causing the appearance of excited 0_2 atoms were taken into account: absorption of direct solar radiation by 0_2 atoms in lines of the triplet 1304 A and excitation by fast electrons arising during the photoionization of atmospheric gases by solar hard UV radiation. In the computations the vertical distribution of oxygen and carbon dioxide was assumed to correspond to diffusional equilibrium with a constant exospheric temperature of 290 K and for the CO_2 concentration at 145 km the value $2 \cdot 10^{10}$ cm^{-3} was used. The most important variable parameter was the density of atomic oxygen n_0 at 150 km. Other important considerations and parameters were taken into account. Under these various conditions the n_0 values $3.7 \cdot 10^8$ and $4.0 \cdot 10^8$ cm^{-3} were obtained for "Venera-11" and "Venera-12" respectively. The value obtained using data for the Pioneer Venus Orbiter was $6.6 \cdot 10^8$ cm^{-3}. Figures 1; references: 7 Western.
[85-5303]

UDC 523.42;523.877

PHYSICAL MODEL OF VENUS

Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 16, No 1, Jan-Mar 82 (manuscript received 18 May 81) pp 18-26

ZHARKOV, V. N. and ZASURSKIY, I. Ya., Institute of Physics of the Earth, USSR Academy of Sciences

[Abstract] The authors construct a parametrically simple model of Venus for the purpose of determining that planet's thermal and kinetic coefficients

as functions of density and temperature. Since so little data on Venus is available, the model relies heavily on the fact that Venus is the planet most like Earth. On the basis of this model, the authors discuss the thermodynamics of Venus's mantle and core, as well as the mantle's viscosity and thermal and electric conductivity. Figures 9; references 13: 7 Russian, 6 Western.
[88-11746]

UDC 523.4

STRUCTURE OF CIRCULATION OF VENUS'S ATMOSPHERE AND POSSIBLE IRREGULARITIES IN ITS SPEED OF ROTATION

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 8, No 5, May 82 (manuscript received 4 Dec 81) pp 312-317

GOLITSYN, G. S., Institute of Physics of the Atmosphere, USSR Academy of Sciences, Moscow

[Abstract] Data obtained by radiointerferometry from four "Pioneer-Venus" descent probes give grounds for formulating a hypothesis about the possible existence of several axially symmetric circulation cells in the meridional plane and the deeper layers of the atmosphere that are one above the other. Other data indicate that the atmosphere is moving faster than the planet, which contradicts the law of conservation of the angular moment for the planet-atmosphere system. The author formulates a qualitative hypothesis to explain this paradox, using Earth and its atmosphere as his starting point. He also studies the possibility that the smaller moment of the planet's body and the greater mass of its atmosphere (both in comparison with the Earth) may cause fluctuations in the length of its day. Finally, he concludes that the situation on Titan is probably analogous to the one on Venus. References 12: 4 Russian, 8 Western.
[105-11746]

UDC 523.42:550.423

INTERNAL STRUCTURE OF VENUS AND IRON CONTENT OF PLANETS IN TERRESTRIAL GROUP

Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 16, No 1, Jan-Mar 82 (manuscript received 15 Oct 80, after revision 18 May 81) pp 3-17

KOZLOVSKAYA, S. V., Institute of Physics of the Earth, USSR Academy of Sciences

[Abstract] The author attmpets to determine the difference between the composition of Venus and the Earth by modeling, since calculations (using

and Earthlike model) indicate that Venus's density should be 1.7% more than it is. After setting up the model she discusses variations in the composition of Venus's mantle and core, using possible alternative density values. By analogy with two different hypotheses about the composition of the Earth's mantle, she arrives at several possibilities for Venus's total iron content. Then, using models of the internal structure and composition of the planets in the terrestrial group (Mercury, Venus, Earth, Mars), she attempts to determine the percentage of iron and silicates in their makeup. Figures 14; references 38: 13 Russian, 25 Western.
[88-11746]

UDC 523.43;523.754

LATITUDINAL CHANGES IN DENSITY OF MARS'S CORE

Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 16, No 1, Jan-Mar 82 (manuscript received 16 Feb 81) pp 34-36

DUBROVSKIY, A. S. and CHIKANOV, Yu. A., Udmurt State University imeni 50-letiye Velikogo Oktyabrya

[Abstract] The authors investigate latitudinal changes in the density of Mars's core, using A. M. Shcherbakov's method, in which the density function is represented as a generalized Fourier series. After calculating the density at the center of the planet by two different formulas and then calculating the densities at certain depths for the entire range of planetary latitudes and comparing the results, they reach the following conclusions: 1) a study of latitudinal density variations makes it possible to evaluate zonal boundaries within a planet; 2) based on the tracking of latitudinal variations at depths of 70 and 700 km, it appears that the former is the thickness of the crust and the latter is where the transitional layer between the upper and middle mantle occurs; 3) the transition from the core to the mantle is probably at a depth of 1,050 km and there may or may not be a lower mantle. Figures 1; references 5: 2 Russian, 3 Western.
[88-11746]

UDC 523.43

SOME TYPES OF CONTINENTAL DEPOSITS ON MARS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEOLOGIYA I RAZVEDKA in Russian No 3, Mar 82 pp 68-72

MAKAROVA, N. V. and KATS, Ya. G., Moscow State University imeni M. V. Lomonosov

[Abstract] The authors use data gathered by Soviet and American automatic interplanetary stations to try to determine the composition of aeolian and

gravitational deposits on Mars. Since wind is the most active force on Mars, the former are more common. The primary formations causing aeolian deposits are craters, where material builds up on the windward side and behind which "tails" (30-50 km long, as opposed to 2-5 km on Earth) of deposited material form. There are also aeolian deposits inside many craters. The authors conclude that the Martian aeolian deposits are very similar to terrestrial ones. The primary forms of gravitational deposits are landslides and collapses. The basic kinds of rock seen are basalt on top of what is most likely tuff, ash, or ancient regolith. Some attention is given to attempting to estimate the ages of these continental deposits. References 14: 5 Russian, 9 Western. [77-11746]

UDC 612.014

DEPENDENCE OF RADIATION DOSE ON 'SALYUT-6' STATION ON SOLAR AND GEOMAGNETIC ACTIVITY INDICES

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 1, Jan-Feb 82 (manuscript received 9 Oct 80) pp 151-153

BONDARENKO, V. A., KOLOMENSKIY, A. V., TIBANOV, A. P., TEL'TSOV, M. V. and SHUMSHUROV, V. I.

[Abstract] The authors try to determine what factors affect the radiation dose received during manned spaceflight, using data gathered during a total of 421 days of flight time on board the "Salyut-6" station. The parameters they take into consideration are: Wolf number; density of the flow of the Sun's radio-frequency emissions on wavelength 10.7 cm; counting rate of the neutron monitor at Apatity Station; the geomagnetic field's perturbation index; orbital altitude. The authors conclude that the contribution of galactic cosmic radiation to the dose received at orbital altitudes of 300-410 km is negligible, but they do not succeed in determining the contribution of the Earth's radiation belts as a function of variations in solar and geomagnetic activity, although they note that the entire period studied was one of relatively little such activity. Figures 2; references 7: 6 Russian, 1 Western.
[62-11746]

UDC 539.014

INVESTIGATION OF EFFECT OF SPACEFLIGHT FACTORS ON CHROMOSOMES IN BONE MARROW CELLS OF RATS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 1, Jan-Feb 82 (manuscript received 4 Jun 80) pp 154-155

BOBKOVA, N. N.

[Abstract] The author gives the results of an analysis of chromosome aberrations in the bone marrow cells of rats after a 22-day spaceflight.

There were 15 experimental and 16 control animals that were killed and analyzed on the 2nd and 27th days after the flight. The chromatid aberrations observed in both groups for both periods were within the known limits of spontaneous aberration. Figures 2; references 11: 5 Russian, 6 Western.
[62-11746]

UDC 612.821.6

CONDITIONED RELFEXES OF WHITE RATS DURING SPACEFLIGHT

Moscow ZHURNAL NERVNOY DEYATEL'NOSTI IMENI I. P. PAVLOVA in Russian
Vol 32, No 2, Mar-Apr 82 (manuscript received 29 Apr 81) pp 263-268

APANASENKO, Z. I., KUZNETSOVA, M. A., MEYZEROV, Ye. S. and SEROVA, L. V.

[Abstract] An experiment was carried out to study the conditioned reflex activity of rats during presence aboard a spaceship. Data were obtained on the nature of the changes in the central nervous system (CNS) during the flight. The animals used were white rats weighing 300-320 g at the beginning of the experiment. Over the course of 18.5 days one group was exposed aboard the "Cosmos-1129" biosatellite, whereas two other groups served as a ground control. One of the control experiments was preliminary and the other was synchronized with the flight and duplicated all conditions other than weightlessness. During the preparatory period the aminals were adapted to all spaceflight conditions other than weightless and alimentary conditioned reflexes to light signals were acquired. Each day the animals were subjected to two strong positive, two weak positive and two differentiated signals. In addition to the light signal, the animals were adapted to a sound stimulus (opening of the feed box). All the observed changes indicated a decrease in the level of conditioned reflex activity during the flight period. There were changes in the latent periods of the reflexes which may be related to the nature of movements in a state of weightlessness, but a role also was undoubtedly played by the higher parts of the CNS. Under flight conditions a state of inhibition evidently develops in the higher parts of the CNS; its intensity could differ in individual flight stages. Both excitation and inhibition processes were weakened during spaceflight, inhibition being affected to a greater degree. The observed deviations were of a moderate degree, but were clearly expressed during the entire flight. When the flight terminated there was a tendency to an increase in the level of the conditioned reflexes, but control levels were not reached. Figures 3; tables 1; references 12: 7 Russian, 5 Western.
[116-5303]

UDC 778.38

EXCHANGE OF HOLOGRAPHIC INFORMATION BETWEEN 'SALYUT-6' SPACE STATION AND FLIGHT CONTROL CENTER

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 2, Feb 82 pp 5-11

[Article by Zh. Gurragcha (Mongolian People's Republic), S.B. Gurevich, V.A. Dzhanibekov, B.Ye. Kashonov, V.V. Kovalenok, V.B. Konstantinov, M. Kordero (Cuba), S. Mesa (Cuba), A.V. Militsin, R. Oms (Cuba), V. Rivera (Cuba), M. Rivero (Cuba), B.F. Ryadinskiy, V.P. Savinykh, V.K. Samsonov, M.S. Cheberak, D.F. Chernykh and L.I. Chuykina]

[Text] During the manned expeditions on board the "Salyut-6" station there was continuous, bilateral television communication between the station and Earth, which made it possible to observe the cosmonauts' actions and instruments in the station from Earth and some terrestrial objects and people from the station. The tasks carried out via television communication were limited, so no demands were made on it for the transmission of information, completely without loss, within the framework of the television standard.

The expansion of the scientific research, technological and monitoring-testing work done on the station made it necessary to place on the agenda the question of increasing the amount of information exchanged between the Earth and space and, correspondingly, improving the efficiency of the communication facilities, including the television equipment. The television equipment on board the station had already become a component part of the facilities used for conducting experiments.

The use of holographic information transmission methods can contribute to a further improvement in the efficiency of television equipment in space. The functioning of holographic television, including the transmission of holograms over a television channel, was previously analyzed under terrestrial conditions [1], and it was established that holographic television has a whole series of advantages over standard television:

transmission over a communication channel of a three-dimensional image and complete analysis of this image at the output, including an examination of it from different angles of approach, and analysis of the details of objects located in different planes;

transmission without contrast distortions of objects with a broad brightness range;

improved resistance to interference.

The realization of these and other advantages of holographic television requires the creation of high-quality equipment, all the elements of which have

frequency-contrast characteristics that are close to ideal, and spatial light modulators that satisfy these conditions and are used to obtain the image reproduced from a transmitted hologram. It is also necessary to have a substantial increase in the number of transmittable elements, either by expanding the channel's frequency band or, if it is not expanded, by reducing the frequency of the frames in order to obtain a high-quality image of the three-dimensional object when transmitting a hologram.

It has not been possible to overcome all the difficulties at this time, so the conclusion that has been reached with respect to holographic television is that right now only its technical use is possible and that before the introduction of holographic television for three-dimensional color television broadcasting, quite a few more years of careful work will be necessary.

The value of the joint utilization of holography and television in space and the necessity of evaluating the possible difficulties arising in connection with it led to the formulation of an experiment in which holograms were transmitted both from the "Salyut-6" station to the Flight Control Center and from the Center to the station.

This experiment was included in the international program of research realized in the "Intercosmos" program. Specialists from the USSR, the Republic of Cuba and the Mongolian People's Republic participated in the preparation and conduct of this experiment. Others who participated were the members of the international crew of the "Salyut-6"-"Soyuz-T-4" space complex: cosmonauts V.V. Kovalenok, V.P. Savinykh, V.Z. Dzhanibekov and Zh. Gurragcha.

Plan of Experiments for the Television Transmission of Holograms From "Salyut-6" to Earth and From Earth to "Salyut-6"

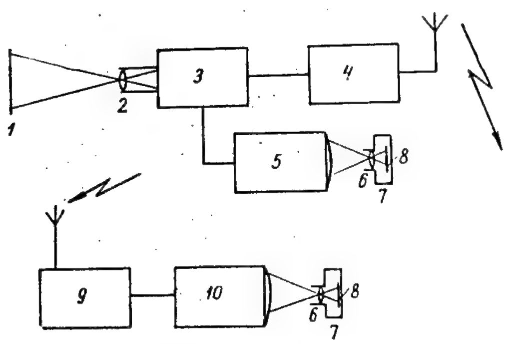


Figure 1. Plan of "Hologram-la" experiment: 1. hologram photograph; 2. television camera lens; 3. television camera; 4. "Salyut-6" station's transmitter; 5. monitoring VKU [video control unit]; 6. lens; 7. camera; 8. photographic film; 9. receiver on Earth; 10. ground VKU.

The first experiment, entitled "Hologram-la," evaluated the quality of the transmission of a photographic hologram image from "Salyut-6" to Earth over a television channel, while the second--"Hologram-lb"--did the same for a hologram transmitted from Earth to "Salyut-6."

The "Hologram-la" experiment was conducted according to the following plan (Figure 1):

1. Enlarged images were manufactured on Earth and delivered to "Salyut-6."

2. The hologram images were projected onto the photosensitive layer of the "Salyut-6" station's on-board camera.

3. The video signal of the hologram image reached the ground stations and formed hologram images on video control units, including a "Telefot" unit, from which the image was photographed on film

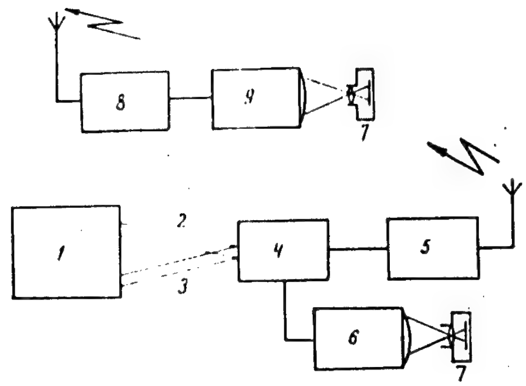


Figure 2. Plan of "Hologram-1b" experiment: 1. holographic unit; 2. lens beam; 3. reference beam; 4. television camera without lens; 5. transmitter; 6. monitoring VKU; 7. camera; 8. receiver on "Salyut-6"; 9. VKU.

The hologram images being transmitted were also photographed from the screen of a video control unit on board the "Salyut-6" station.

4. The image of the objects (see No 1) was reproduced from the developed film. In order to achieve high-quality image reproduction, there was an additional preliminary re-exposure of the holograms on photographic plates, which made it possible to eliminate phase distortions.

5. The images reproduced from the holograms were photographed and the special features of the transmission of holographic information over the television channel linking "Salyut-6" and Earth were analyzed.

The "Hologram-1b" experiment was conducted according to the following plan (Figure 2):

1. The hologram's interference field was formed in a "Svet" holographic unit, the basis of which is a (Makh-Tsander) interferometer. The interference field was then recorded on a videotape recorder.

2. During television communication with "Salyut-6" this video recording was transmitted to the station.

3. During the transmission, a special adapter was used to photograph the holographic image from the video control unit on board the "Salyut-6," while on Earth control photographs of the transmitted holograms were made with the "Telefot" unit.

4. The films of the holograms were developed in a laboratory, then rephotographed on special photographic plates, with the image of the holograms being reproduced on these plates.

Preparatory Work

Before the space experiment could be conducted, a certain amount of preparatory work had to be done. For instance, the objects of which holograms were to be made for the "Hologram-1a" and "Hologram-1b" experiments had to be designed and manufactured. All of the objects were half-rings with inner and outer diameters of 10 and 20 mm, respectively. Such a configuration insures an isotropic spectrum of the hologram's spatial frequencies [2]. A half-ring was divided into several sectors in which there were groups of radial lines with different angular pitches. The set of semicircular rings that was produced makes it possible to evaluate the recording unit's resolution in the range from 0.2 to 50 lines/mm. Figure 3 depicts samples of the rings produced by Soviet (Figure 3a) and Cuban (Figures 3b and 3c) specialists.

The following objects were also produced with the same shape: a half-tone object that was a gradation step wedge (Figure 3d) and object transparencies (Figures 3e and 3f).

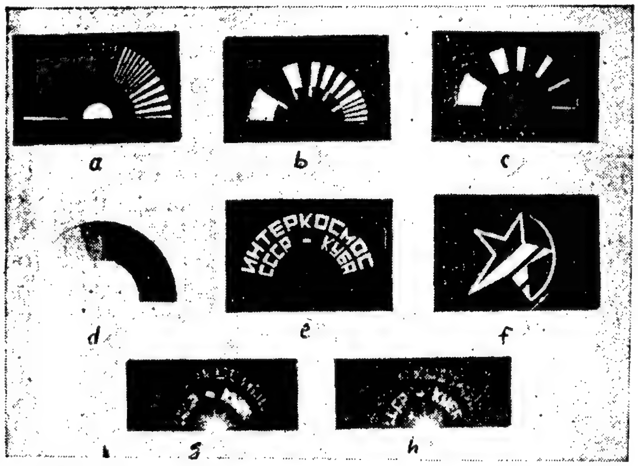


Figure 3. Objects of which holograms were made: a. semicircular ring No 1 (USSR); b. semicircular ring No 2 (Cuba); c. semicircular ring No 3 (Cuba); d. gradation step wedge; e. object transparency (Cuba); f. object transparency (USSR); g, h. three-dimensional object transparency synthesized by the holographic method, showing photographs of the reproduced images with focusing in the near and far planes.

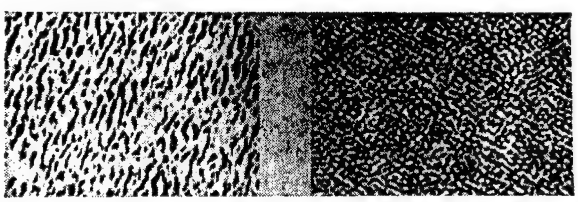


Figure 4. Fragments of working photocopies of holograms: a. binary (Cuba); b. half-tone (USSR).

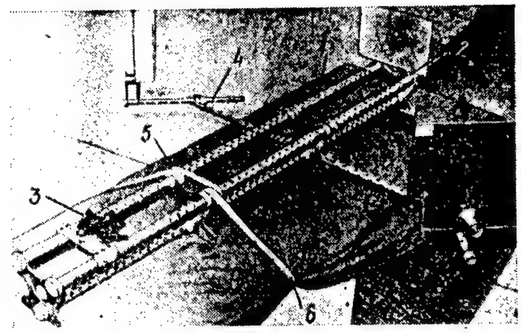


Figure 5. Photograph of general-purpose base (Cuba): 1. guide rods; 2. hologram attachment bracket; 3. television or photographic camera attachment bracket; 4. lamp attachment bracket; 5. table; 6. attachment of base to table.

In order to demonstrate the possibility of transmitting information about volume, a hologram of a three-dimensional object transparency was synthesized (Figures 3g and 3h).

The holograms of these objects were produced on LP-3 plates with a stationary holography unit. They were 9 x 12 mm in size, and their spatial frequency was no more than 10 lines/mm.

Enlarged photocopies measuring 120 x 160 mm were made from these holograms. Part of them were made on standard, matte-finish photographic paper and part on glossy, high-contrast paper. Fragments of the working photocopies are shown in Figures 4a and 4b.

The Cuban specialists manufactured a piece of gear that was used on board the station: a general-purpose base for mounting a hologram photograph, lamps and the station's camera (Figure 5) and a tube bracket for attaching the photographic equipment to the VKU.

A portable "Svet" ground unit was manufactured for use in the "Hologram-1b" experiment. Figure 6 is an optical diagram of this unit, which was used to make a video film of the holograms of the five test objects at the Leningrad Telecenter.

During the final stage of the preparations for the experiment, holograms were transmitted over a closed-circuit, ground television channel, with the transmitted holograms being recorded on photographic film. This preparatory stage made it possible to work out the techniques used in the conduct of the "Hologram-1a" and "Hologram-1b" experiments.

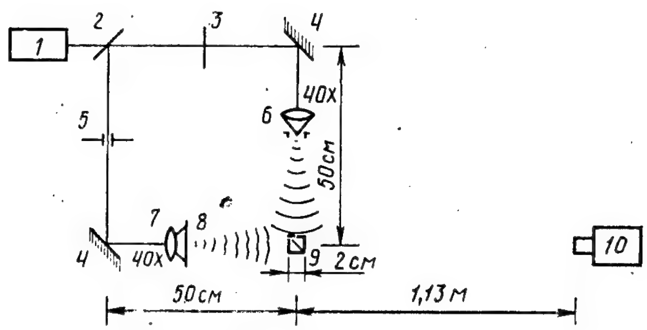


Figure 6. Diagram of "Svet" holographic unit: 1. laser; 2. light splitter; 3. attenuator; 4. mirror; 5. diaphragm; 6. space filter; 7. microlens; 8. lens; 9. light splitter; 10. television camera.

Before the "Hologram-la" experiment was begun, the following operations were performed on board "Salyut-6": the general-purpose base and bracket were assembled; lamps were set up; the television cameras were set up; the photographic camera was loaded; the photographic camera was mounted on the bracket; the installation was aligned; a report was sent to Earth that the station was ready to carry out the experiment.

The necessary equipment was also prepared on Earth: the "Telefot" unit for photographic recording of the televised frames and the VK23V60 video control unit; "Zenit-Ye" and "Kiev-10" cameras, loaded with "NP-20" film. The TF-1 unit and the VKU were tuned according to Table 0249 and a $\sin^2 x$ signal.

The "Zenit-Ye" camera, with its "Industar-50" lens, was coupled with the TF-1 unit. Since the illumination time for a single frame was constant, the exposure was controlled by changing the lens's diaphragm. Two lens diaphragm values--5.6 and 4--were used. The "Kiev-10" camera, with its "Industar-61" lens, was coupled with the VKU. In this case, different exposure times were set: 1/15, 1/8 and 1/4 s, with a diaphragm opening of 5.6.

Conduct of the Experiment

On a command from Earth, the photocopies of the holograms and test objects were set up and changed. After a stable image was obtained on the screens of the ground VKU's, they were photographed: on board the station, using a "Praktika YeYe2" camera with a "Pentakon Elektrik" lens 1/8 50 [sic] on film (three frames with exposure times of 1/15, 1/30 and 1/8 s with diaphragm openings of 8, 5.6 and 4); on Earth, two frames with the "Zenit-Ye"-TF-1 complex and three with the "Kiev-10"-VK23V60 VKU complex.

The holograms were changed at about 1-minute intervals.

During the "Hologram-la" experiment, a time mark that was illuminated in the lower righthand corner of the frame was introduced into the television channel. When the experiment ended, the exposed film was removed from the cameras, labeled and placed in the appropriate cans. After the materials were delivered to Earth, the films were processed by the appropriate developers.

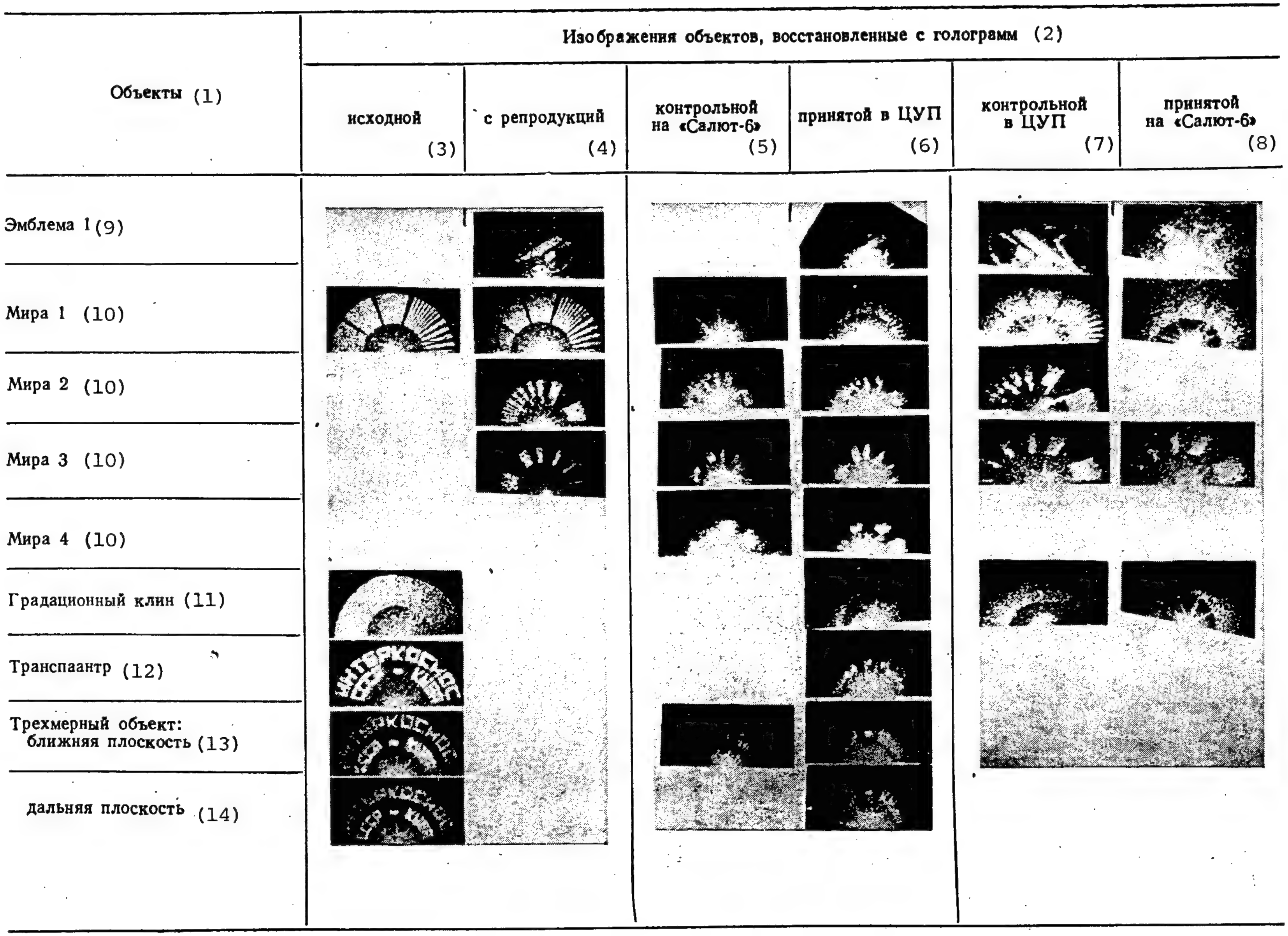


Figure 7. Photographs of reproduced images.
[Key on next page]

Key to Figure 7:

1. Objects
2. Images of objects reproduced from holograms
3. Original
4. From reproductions
5. Control on "Salyut-6"
6. Received at Flight Control Center
7. Control at Flight Control Center
8. Received by "Salyut-6"
9. Emblem No 1
10. Semicircular ring No .
11. Gradation wedge
12. Transparency
13. Three-dimensional object: near plane
14. Far plane

An evaluation of the negatives showed that the photographic quality of the obtained materials is completely satisfactory and that they are suitable for further image recovery work

Image Reproduction From Transmitted Holograms

In order to reproduce the test object images from the holograms, they were first rephotographed from the original film onto photographic plates. This intermediate operation makes it possible to improve the quality of the reproduced image. Actually, when holograms are reproduced directly from film there appear significant phase distortions caused by twisting of the film and nonuniformity of the substrate. When the image is rephotographed in normal light, using a photographic plate, these distortions do not appear. When the images are reproduced from the plates, the phase distortions prove to be substantially smaller [3].

The rephotographing was done with a "Mikroplanar F 6.5 x 4.5" high-resolution lens and "ORWOLP-1" and "LP-2" plates. During the rephotographing of the transmitted holograms, the size of the hologram image on the plate was set at 9 x 12 mm. Since the focusing requirements during the rephotographing were very rigorous, the setting was checked for clarity of image with a microscope. The plates were developed in "ORWO-71" developer for 5 minutes, at a temperature of 20°C.

The images from the transmitted Fourier holograms that had been reproduced on the plates were reproduced by a method utilizing a converging beam. In this case, two conjugate, real images are formed in the focal plane and then recorded on KI-2 photographic film with the help of the "Kiev-10" camera. The LG-38 laser used in the setup provides exposure times on the order of 1/15-1/16 s. The exposed film was developed in D-76 developer for 10 minutes at a temperature of 20°C.

Photographs of the reproduced images are presented in Figure 7.

Methods of Evaluating the Quality of an Image Reproduced From a Transmitted Hologram

The basic measurable parameters that can be used to judge the quality of a transmitted image are usually assumed to be the size of the image, image resolution, the number of gradations and the signal-to-noise ratio. A characteristic of a three-dimensional image is its depth.

The effect of the transmission system on an image reproduced from a hologram that has been transmitted over it is determined by the type of encoding of the optical signal registered in it. In the "Hologram-la, -lb" experiments Fourier holograms were used; consequently, in these holograms the optical signal is a Fourier image of

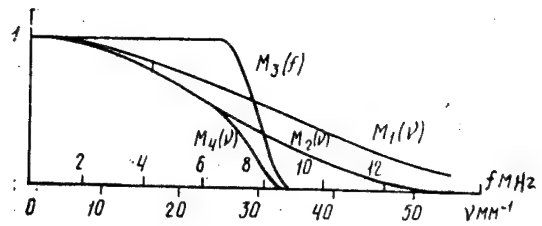


Figure 8. Frequency-contrast characteristics: M_1 = of the image reproduction system; M_2 = of the transmitting system; M_3 = of the communication link; M_4 = of the entire television system.

the object's transmission function. Therefore, the size of the image reproduced from such a hologram that has been transmitted through the system will be determined by the system's resolution, while image resolution will be determined by the dimensions of the transmitted section of the hologram (the dimensions of the transmitting television tube's raster).

It is possible to achieve a sharp reproduced image edge only when the frequency-contrast characteristic (ChKKh) has the form of an ideal rectangle with cutoff frequency ν_{max}. In practice, the image transmission system's ChKKh has the form of a monotonically falling curve (Figure 8) [4]. For this reason the reproduced image's brightness diminishes as the distance to the point source increases. If the object's brightness were uniform during the holography process, then by the change in the reproduced image's brightness it would be possible to judge the shape of the transmitting system's ChKKh. Consequently, by measuring the brightness of the reproduced image of a test object (semicircular ring) along the radius, we obtain the system's overall ChKKh.

The dependence of the system's ChKKh on the transmitted picture's contrast can be obtained by measuring the change in brightness of the reproduced image of the halftone object along the radius in each section of the half-ring.

Resolution in the image of a semicircular ring reproduced from a transmitted hologram is observed visually along the boundary of the washout of the lines in the sectors.

An objective evaluation of the resolution can be obtained by scanning across the lines of the corresponding sector of the image of a semicircular ring for different radii. The maximum resolution of the holographic television system is found for the radius and number of the sector in which the contrast of the image of the semicircular ring is 5 percent.

Discussion of the Results

In Figure 7 we see the reproduced images from part of the holograms that were obtained in the "Hologram-1a" and "Hologram-1b" experiments.

Along the lines of the table that is Figure 7 we see images of the same original object, while in the columns we see images reproduced from holograms that have passed through the same channel.

A comparison of the images in the second column (reproductions of holograms from images that were recovered from transmitted holograms) indicates that the "Hologram-1a" and "Hologram-1b" experiments were successful. This is particularly noticeable in the images of the semicircular rings on lines 2, 3 and 4.

From the series of images of a semicircular ring along a line it is obvious that changes in the image accompany each operation. For instance, in the second column

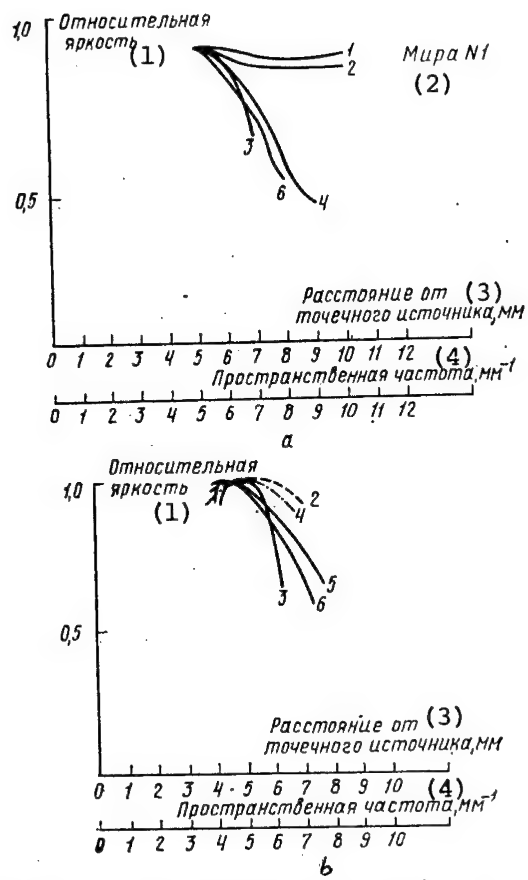


Figure 9. Change in brightness in images: a. semicircular ring No 1; b. semicircular ring No 3, as reproduced from holograms: 1. original; 2. reproduction; 3. control in "Hologram-1a" experiment; 4. transmitted in "Hologram-1a" experiment; 5. control in "Hologram-1b" experiment; 6. transmitted in "Hologram-1b" experiment.

Key:
1. Relative brightness
2. Semicircular ring No 1
3. Distance from point source, mm
4. Spatial frequency, mm^{-1}

there are images reproduced from hologram reproductions. This means an image of a hologram on a photographic plate that was obtained as the result of photographic operations with a hologram alone; that is, enlargement of a hologram measuring 9 x 12 mm to 120 x 160 mm, rephotographing of it, with reduction, on 35-mm film with a full-frame (photosimulation of transmission over the TF-1 channel at the output) or half-frame (the VKU on the "Salyut-6") format. Further, from this developed film the hologram was rephotographed on an LP-1 and an LP-2 plate, with reduction to a size of 9 x 12 mm. Thus, a comparison of the images in the first column (images reproduced from the original holograms) with those in the second (images reproduced from hologram reproductions) shows that even at this stage it is possible to see a change in the image, although it is not a very noticeable one. It is manifested as a reduction in brightness toward the edges of the image. It is most noticeable in the third column, which contains images reproduced from the control holograms of experiment "1a" (transmitted holograms photographed on the screen of the "Salyut-6" station's VKU). Since all the images in this column differ substantially from the ones in the fourth column, which contains images reproduced from holograms that had been transmitted to Earth, it is possible to assume that in this case there was some inaccuracy in the focusing of the image on the VKU's screen or in the setting of the camera for clarity of definition.

After comparing the images of the semicircular rings that were reproduced from transmitted binary (bilevel) half-tone holograms, it can be stated that the transmission of binary holograms yielded a reproduced image of even better quality. This is understandable, since these holograms had the maximum possible contrast (close to unity).

In experiment "1b" the good recording of the hologram images on the videotape recorder insured the good quality of the images reproduced from the control holograms photographed from the TF-1's screen in the Flight Control Center, while the more powerful terrestrial video signal insured the satisfactory quality of the image reproduced from a transmitted hologram. However, two factors in experiment "1b"

require a more detailed analysis: first, it is necessary to determine the reasons for the vertical elongation of the reproduced images; second, the reasons for the loss of resolution in semicircular ring image 14 must be ascertained.

The last three lines demonstrate the three-dimensional nature of an image reproduced in the transmitted holograms: the inner inscription is focused in two planes (in front of and behind the focal plane). The reasons for the disappearance of the outer inscription in the reproduced image are still unclear.

A rapid analysis of the radial change in brightness of the semicircular ring images reproduced on the second and fourth lines showed that in each column the change is of an almost identical nature (Figure 9). Changes in brightness are determined by the system's ChKKh. If the original object has a uniform brightness distribution, then by the nature of the change in brightness in the reproduced image (from a transmitted hologram) it is possible to determine the system's ChKKh. In order to do this, the graphs' X-axes should be calibrated in units of spatial frequencies.

Thus, the "Hologram-1a" and "Hologram-1b" experiments showed that despite the deterioration in quality of a reproduced image, the transmission of holograms to and from the station makes it possible to obtain images of binary half-tone and three-dimensional objects.

The radial distribution of brightness in an image makes it possible to evaluate the photographic television system's ChKKh. For the given communication channel frequency band, these results can be regarded as a positive answer to the question of the possibility of using holography in such systems.

Conclusions

1. The "Hologram-1a" and "Hologram-1b" experiments, in which holographic information was transmitted from "Salyut-6" to the Flight Control Center and in the opposite direction, respectively, confirmed the possibility of transmitting such information in both directions.

2. The experiments revealed the nature of the losses of spatial and gradational information about the transmitted objects that arise during the exchange of holographic information over Earth-space television links. Only comparatively low-frequency information (such as an object displacement interferogram) can be transmitted without losses. When it is necessary to carry out the holographic transmission of an image without losses, the rate of information transmission should be reduced (a single hologram should be transmitted in several frames) or the number of elements in a frame should be increased.

3. The high sensitivity of hologram transmission to various television channel defects makes it possible to use such a transmission as a convenient and rapid method for monitoring the parameters of an entire Earth-space television system from input to output.

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11746
CSO: 1866/67

ASPECTS OF WORK ON FLIGHT CONTROL OF SPACE VEHICLES

Moscow ZEMLYA I VSELENNAYA in Russian No 2, Mar-Apr 82 pp 36-40

[Interview with Am. Aleksandrov, doctor of technical sciences: "Conversation at the Flight Control Center"]

[Text] This "Conversation at the Flight Control Center," offered the readers of this journal, like preceding articles [ZEMLYA I VSELENNAYA, No 5, pp 12-14, 1980; No 6, pp 28-30, 1980 -- Editor], contains an exposition of some aspects of work on flight control of space vehicles. The thoughts expressed in the conversations are applicable to the organizational activity of virtually any creative body of workers involved in the control of complex systems.

G. S. Titov, HSU, USSR flier-cosmonaut, lieutenant general of aviation

[Question] We have visited centers for the control of satellites and distant space vehicles, as well as specialized space centers for communication, meteorology and study of natural resources. What distinguishes the control of space vehicles of different types? And what does the operation of all these centers have in common?

[Answer] Already in preparation for launching distant space vehicles have some priority over satellites and become the principal concern of the cosmodrome and the command-measurement complex (it goes without saying that the greatest priority is for manned ships).

The reason for the special attention to interplanetary stations is that a delay in launching of a few seconds threatens a scrubbing of the launching on the planned day. It is not always possible to shift the launching to the next or a subsequent day and sometimes it is necessary to dismount a part of the scientific instrumentation. It is necessary to wait for several years for the next optimum dates.

Now about the differences in control means and methods. Matched and separate systems of trajectory measurements, telemetric and control systems are used in systems in circumterrestrial space. In distant space only a single radio link (radio system) is always used, operating in different combinations of trajectory measurements and telecontrol, in command-programming, television and communication or other regimes. The radio signals transmitted by vehicles in distant space are naturally much weaker than satellite signals. This makes it necessary to use antennas with a very great effective surface (there are about 10 such antennas in the entire world) capable of intercepting from the chaos of all kinds of signals and noise that single signal transmitted from the interplanetary station. In order to adhere to the required accuracy in measuring the trajectory and reliable transmission of different types of information over enormous distances despite the insignificant signal level use is made of exceptional measures: work in a very narrow frequency band, decrease in the rate of transmission of information and others. None of this is required for control of vehicles in near space.

Distant space vehicles, withdrawing millions of kilometers from the earth, over the course of many hours remain in the zone of radiovisibility of one control station (instead of several minutes for satellites in low orbit). In order to ensure continuous communication with interplanetary stations it is usually adequate to have two command-measurement points. For example, the remote space communication center and a ship located in the western hemisphere can ensure a virtually around-the-clock communication with an interplanetary station. There is no need for a multisided coordination of activity of a great number of command-measurement points through which satellite systems are alternately controlled.

In general, there are many differences in the apparatus for the control of vehicles in near and distant space, in measurement methods, in the system for coding signals, even in the principles for the reception and transmission of television signals, not to mention the design of the vehicles and antennas. It goes without saying that operation also differs substantially.

[Question] All these differences are in equipment or in operation. What about control?

[Answer] The same is true of control. The ballistic computations for distant space vehicles are directly related to astronomy, celestial mechanics, motion of the planets. These computations require greater accuracy.

The more distant an interplanetary station withdraws from us, the more difficult it is to receive telemetric data from it. Dialogue with it does not transpire rapidly.

At the centers for flight control of satellite systems (it goes without saying, if aboard the satellite there is complete order and the flight regime is established) a characteristic, measured, "ebb-and-flow" rhythm is clearly manifested. It is predetermined by the frequency of recurrence of working revolutions; it is as even as quiet breathing. Each type of vehicle, its mission and flight program form the periodicity of work and rest, its rhythmic pattern of control.

The activity of the control specialists for the space vehicle "dominant" during this period governs the work rhythm of the center as a whole.

...A satellite is approaching the zone of the first control point along the flight trajectory. A control panel, illuminated maps, television screens and displays light up. The duty crew assumes their work places. The readiness of the facilities for tracking, control and reception of information is checked. Computers are switched on for the reception and processing of data from aboard the vehicle.

...The satellite is in the zone. Every minute of all the services at the flight control center is allocated and saturated with work. It is necessary to receive telemetric information, evaluate the state of the vehicle, determine how the program being carried out on board is proceeding, issue planned commands and check on their transmission, evaluate the energy balance on board ... And if something has not gone right, a command has not been received, some mission has not been accomplished, the command is repeated and possibly changes will be made in the program so that the mission will be completed on the next revolution.

...The command-measurement complex is ending the last communication session. The satellite is leaving its zone. Reports on the collected information are being received; an evaluation is being made as to whether it corresponds to the program and the requirements of users.

Finally the television screens go blank, the illuminated maps, panels and displays are cut off. Now it is possible to get up from the desk, leave the control panel, depart from the hall and even take care of matters not directly related to the completed revolution. Man adapts, becomes accustomed to such a work rhythm.

The activity of the center looks somewhat different when the operating regime of the satellite has not yet been established. And it is a completely different matter if on board not everything is normal and a struggle is being waged to bring about order in space. The "ebbs," the dropoff in tension, is not felt. The operational program on the next revolution in these cases to a high degree is dependent on the results from the preceding revolution. There is a great deal to do in less than 1-1 1/2 hours. And with completion of work on the current revolution the strain of work (with the end of the communication session) does not drop off but even increases. But this is a special, unusual situation.

The rhythmic pattern of control at the remote space communication center looks different in the control of interplanetary stations. The duration of communication sessions in remote space varies from several minutes to several hours and the intervals between them from these same few minutes to many days. Everything is dependent on the tasks, the significance and program of the session, on circumstances. And, to be sure, on the state of the power balance on board. It must be remembered that the requirements on the power balance for remote space vehicles are substantially more rigid and severe and therefore exert an appreciable influence on the duration and periodicity of communication

from the earth to the vehicle and back to the earth. Since in distant space there are no communication sessions repeating with each working revolution, here it is more difficult to "correct," repeat and take care of omissions.

For distant space vehicles there is almost always a culmination point for the flight program (for example, a soft landing, a flight around a planet, descent of a "Lunokhod" on the lunar surface). Accordingly, there is also a culmination in the control. In other words, at some moment flight control assumes a decisive character. If the control specialists at this moment do something incorrectly or simply "not in the best way" -- all their excellent work, lasting many days or months, goes to waste. But even if everything is done beautifully, and the basic information for which the entire flight was made cannot be "taken" and transmitted to the earth, the success of the preceding control stages loses its importance.

[Question] What must be regarded as the culminating, critical moment in flight control, for example, for the "Venera" station?

[Answer] To be sure, it is descent onto the planet and transmission of the information concerning it to the earth. Judge for yourself. An approach to Venus is being made. First it is necessary to enter the narrow crescent of the illuminated part of the planet visible from the earth. Second, the descent module must pass through the narrow entry corridor into the planetary atmosphere. In the event of a very steep entry the vehicle can be destroyed but if the entry is excessively gentle the vehicle may pass the planet by.

Now about the conditions for the transmission of information to the earth. The descent module must transmit all the information to the orbital compartment put into flight around Venus and becoming its satellite or to a compartment flying by the planet (in a "fly-by" variant of launching) and the orbital (fly-by) compartment after processing relays the information to the earth. Such a scheme with the relaying via the orbital compartment makes it possible to reduce the mass of the descent module and also to transmit information in those cases when it is not visible from the earth and cannot immediately send it to the earth.

The receivers of the orbital vehicle, in conformity to a program incorporated on the vehicle, are switched on in advance and conduct a search, a seeking for a signal from the moving descent vehicle. They intercept the signal and track it during the entire communication session. We note that radio communication between the orbital and descent modules is conducted at short (meter) wavelengths, whereas between the orbital vehicle (Venusian satellite) and the earth it is at ultrashort (decimeter) wavelengths. The fact is that for work at short wavelengths there need not be such a precise relative orientation of the orbital and descent vehicles and the decimeter (as well as centimeter) waves are easily collected into narrow beams and more easily overcome the enormous distances.

The television camera, which after the landing makes a circular scan of the terrain to be investigated, sends to earth (again via the newly formed Venusian satellite) signal after signal. The surface radiotechnical complex, processing

the received signals, reproduces a panorama of the Venusian surface.

Flight control of even the same types of vehicles can be extremely different, depending on the purposes, tasks and flight conditions. For example, the scope and character of work of the control specialists during the time of flights of the first and last "Veneras" were simply not comparable. Initially the transmission of information to the earth was at the rate of one (binary) unit per second, whereas at the end it was 250 times more rapid. And, to be sure, control of vehicles of the "Mars," "Venera" and "Luna" types by no means is the same.

[Question] And what about satellites of different types and purposes? Are there differences in their control?

[Answer] The control of vehicles of virtually all types is by means of a single command-programmed method combining radio and telemetric control from the earth with the use of on-board automated systems (including on-board computers). This also predetermines, in particular, the identity of many processes and operations in the control of the most different space vehicles.

Satellites carry systems of two types. A servosystem which ensures the possibility of existence of the vehicle under space conditions and its control. There are systems for power supply, temperature regulation, stabilization, orientation, on-board automation equipment, apparatus for control, telemetry, trajectory measurements and some other instruments. Their tasks, regardless of the type of satellite, are extremely close. For many space vehicles these instruments are of the same type or are even completely standardized, which is attributable to the identical or in any case extremely similar processes and operations involved in the control of the most different satellites. The second group of on-board instruments are those specially selected for the specific type of satellite. For example, scientific instrumentation for research satellites, communication systems for communication satellites, meteorological instruments for meteorological space systems, television and still cameras for satellites studying natural resources.

The universality of the principles for the control of space flights determines the presence of corresponding communication services, standard time services, ballistic support groups, telecontrol and diagnosis groups and teams for the development of commands and programs at all control centers without exception.

[Question] And what can be said about the differences in the control of manned and automatic vehicles?

[Answer] Manned flights introduce many specific elements into flight control, such as: maintenance of uninterrupted two-directional telephonic, telegraphic and television communication with the ship, rigorous monitoring of radiation conditions, constant biomedical telecontrol of the condition of the cosmonauts, regular supplying them with highly precise ballistic data, accomplishment of specialized telemetric monitoring and diagnosis of all life support systems, psychological support of the crews, and finally, rigorous synchronization of all operations of the ground control services with the actions of the crew

(however, without depriving the latter of a certain independence in carrying out certain scientific research work).

[Question] The number and duration of manned flights are increasing rapidly. Scientists and specialists are being sent into space. The number of tasks which can be solved independently by cosmonauts is increasing and manned flights are becoming increasingly autonomous. Can it be expected that the volume of work on earth will be reduced during manned flights and that the life of control specialists will become easier?

[Answer] Work become less and life easier? Quite the reverse! Almost each new mission which is formulated or any new task facing the cosmonauts will without fail impose new tasks on the ground flight support services. Experience shows that control specialists will be faced with new concerns and obligations which, however paradoxical it may seem, with an increase of the autonomy of the ship will considerably increase the responsibilities of the men in the ground control service. And although the possibilities and role of on-board computers in flight control will unquestionably increase, I think that a reduction in the volume of work on the earth is not to be expected. And indeed this will scarcely be advantageous. The economy, the usefulness, must be expected from an increase in the overall result, the total effectiveness of the manned flights.

The proper, optimum distribution of tasks between "vehicle" and "earth," between man and on-board automation systems (including electronic computers), the efficient coupling of the actions of the crew and control center, the expert work of control specialists of all ranks and fields of specialization, have been and remain highly important conditions for the effectivness and safety of space flights of automatic vehicles and manned ships.

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DETERMINATION OF SATELLITE ORBITAL PARAMETERS

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 5, May 82 pp 44-45

[Article by V. Andreyev, candidate of technical sciences]

[Text] In 1957, after the first artificial earth satellite had been put into orbit, ballistics specialists could predict its position on the first revolution with an accuracy to almost a quarter of its period of revolution. But today the time tie-in of a navigational satellite in orbit of one second is no longer surprising. The approach and docking of a space ship and station, flights to planets of the solar system and landing of a descent module in a stipulated region -- all this requires a precise prediction of orbital parameters. It is necessary for calculating flight trajectories and planning the functioning of measurement points in the command-measurement complex, in short, for the monitoring of satellites. Thus, the trajectories of a future flight make it possible to select the time and place for solution of scientific and practical problems. An example of this is the remote sensing of the earth from space. With respect to the effectiveness of operation of meteorological and communication satellites, it is dependent to a considerable degree on proper monitoring. In a general case an orbital prediction ensures preparation of time programs for the operation of on-board instrumentation. Moreover, if the orbits of all satellites present in space are known, it makes it possible to distribute the communication contacts among the measurement points in such a way as not only to ensure implementation of the flight program, but also make efficient use of radioelectronic equipment.

However, prior to being engaged in computing a prediction of satellite motion, the ballistics specialists determine its flight orbit. In actual practice the orbital elements can be calculated using one or two parameters determined by stations with radioelectronic equipment. However, this requires measurements at several points, rather than one, obtained at several, rather than only one measurement point. How are these data obtained?

At first glance it seems adequate to send a harmonic radio signal in the direction of the satellite and after some time $t = 2r/c$ register it. Then the measured phase difference $\varphi = 2\pi f\tau$ of two oscillations -- transmitted and received -- can serve as a measure of range. But it is not possible to realize this idea. The fact is that the φ parameter, read with a phase meter, varies in the range from 0 to 2π. As soon as it exceeds a maximum value, the reading begins again from 0. It is obvious that for an unambiguous measurement of range it is

necessary that the radiation frequency not exceed c/2r. What does this mean? If it is assumed, for example, that the satellite flight range is r = 300 km, we obtain a radiation frequency not greater than 500 Hz. This value is too far from the radio range and accordingly it is virtually impossible to measure range by this method.

However, this overlooks a method for the registry of oscillations separated from one another by a distance considerably greater than the wavelength. There are several such solutions. For example, if a carrier in the ultrashort range with this same frequency 500 Hz is modulated, it is possible to speak of realization of a measuring instrument. The limiting range can be evaluated by the modulation frequency. We thereby ensure an unambiguity of measurement. The required accuracy is attained due to the use of several modulated frequencies. First the range is measured approximately, but unambiguously. Then it is refined at higher and higher modulating frequencies. Systems in which this method is applied are called multiscale systems. The radio signal in them can be modulated by all frequencies simultaneously or in turn.

At trajectory measurement stations it is also common to use the radar method for the radiation of energy with active relaying. The satellite apparatus, receiving a ground station signal, amplifies it and sends it back. This makes it possible to increase the power of the radio signals, and accordingly increase the effective range of the system of trajectory measurements as a whole. The energy of these stations is radiated in very short time intervals. The shorter the pulse, the steeper is the voltage increase front. And this indeed is required for the more precise registry of the response signal, and this means a more precise measurement of range. However, the shorter the radio pulse, the wider the receiver band must be for its correct reproduction. This leads to an increase in noise intensity. This noise distorts the shape and leading edge of the useful signal, that is, leads to measurement errors. In order to maintain a definite signal-to-noise ratio it is necessary to increase the radiation power. But is an unlimited increase in the supply voltage possible? No. Here it is necessary to reckon with the danger of an electric breakdown. In this sense stations with continuous signal radiation are simpler and more reliable. In these stations the required signal-to-noise ratio is brought about not by means of an increase in voltage, but by means of using radiation over a prolonged interval.

Later the merits of pulsed (large effective band) and continuous (simplicity of realization of the signal-to-noise ratio) radiations were combined. Thus pseudorandom radiation radio systems were created. We will examine their operating principle.

The expression for the amplitude of harmonic oscillations is well known: $u = V \sin (2\pi ft + \varphi_0)$. The parameters in the formula have a simple physical sense. For example, V is the maximum value of the supply voltage, f is frequency, φ_0 is the initial phase.

We will replace the initial phase φ_0 by the function $\varphi(t)$, which changes in conformity to a "pulsed switching" law, assuming the value 0 or π. The times of possible switching and pulse duration are stipulated by a generator of random numbers (hence the name pseudorandom). The form of this function is shown

in the figure [not reproduced here]. The initial phase in signals of such a type in the course of a period a virtually equal number of times assumes both its values 0 or π. The signal spectrum does not differ from the spectrum of an individual pulse, and the energy does not differ from the energy of a continuously radiated harmonic signal. A measuring instrument constructed on this principle can ensure an unambiguous and precise determination of range for any distance of the satellite from the earth. The question arises: how can useful information be discriminated in this signal? After all, it is drowned in noise and the useful power is distributed in the entire radiation interval.

In actuality, a detector of an ordinary type is not suitable here. However, the problem is soluble. The fact is that in addition to information on the frequency band occupied by a signal in the radio spectrum, the detector receives from the generator random numbers of information on the form of the modulating function. The circuit for seeking synchronization conditions compares the received information with its analogue produced by the generator. Because of its merits this method is coming into increasingly wider use. For example, we can mention a multifunctional space radioelectronic system which together with trajectory measurements accomplishes telemetric control and monitoring of satellite motion.

The Doppler effect serves as the basis for measuring radial velocity: the frequency of oscillation or the wavelength of the signals registered by the detector is dependent on the velocity of motion of their source. The principal reason for this effect is a change in the number of waves falling on the path from the source to the receiver. If the source of electromagnetic oscillations is moved away from the reception point, the signal frequency decreases, and vice versa. This means that by having a generator on a moving vehicle on the basis of the reference and registered frequencies (Doppler frequency) it is possible to determine the velocity of its motion. This is also correct for space technology.

We will place a harmonic signal generator on a satellite and the surface detector is supplied with a narrow-band filter making it possible to narrow the working frequency and thereby have a maximum reduction of the noise. The voltage with the Doppler frequency discriminated by the detector is sent to a counter. There frequency data are accumulated over the course of some time and the mean value, tied in to the current time in the measurement interval, is computed. Systems for radio monitoring of the orbit constructed on this principle came into wide use, especially in the initial period.

And what are the measurement errors? First of all, an inaccurate knowledge of and the inconstancy of the velocity of radio wave propagation exert an effect. The ionosphere and troposphere play the principal role here. For example, the maximum error associated with the troposphere is 0.1-0.2 m/sec. The ionospheric error is dependent on frequency and at centimeter wavelengths does not exceed a few centimeters per second, but at meter wavelengths -- already meters per second. Its value is inversely proportional to the square of frequency.

Second, errors arise due to the instability of on-board and surface reference frequencies. For example, the measurement of radial velocity with an accuracy to 0.1 m/sec is possible with a relative frequency stability of $3 \cdot 10^{-10}$, which

can be ensured only by a quartz generator. Another approach is also possible: use of the interrogation method, when a reference signal is sent from the earth. In this case the frequency instability will be insignificant. However, in this case the measurement autonomy is lost.

Third, the error related to discrimination of the signal, measurement of the Doppler frequency and its tie-in to time. In a general case the radial velocity value in the measurement interval can be represented by an expansion in the form of a series. However, the frequency measurement instrument determines only the mean value, assuming that it changes linearly. Here an error is concealed and indeed it is impossible to tie this mean value in to a specific time.

Averaging in the Doppler frequency counter is not the sole source of dynamic errors. For example, the so-called tracking filter and the measurement instrument itself are not free of instrumental errors. However, their magnitude is much less than those considered. Existing stations for radio monitoring of the orbit measure radial velocity with an accuracy to 0.1 m/sec.

With respect to determination of the direction to a satellite, for this it appears adequate to point a pencil-beam antenna in the direction of the satellite, find the signal maximum and on the basis of the sensor readings on the axes of the supporting-rotating apparatus determine the azimuth and angle-of-elevation values. In actual practice two procedures have become best known; the basis for them is one and the same principle -- search for an equisignal zone. Its essence is as follows.

If two directional diagrams are created which are displaced symmetrically relative to the antenna axis and an equal response signal is achieved in them, this will mean that the satellite is on the line of the geometrical axis of the antenna or in the equisignal zone. Any deviation from it will invariably cause an increase in one signal and a decrease in the other. The fact is that the steepness of the directional diagram on the slopes is considerably greater and accordingly the measurement system becomes more responsive and precise. On the basis of this criterion it is easy to determine the direction of satellite motion.

It would be possible to use an exciter displaced from the dish focus and rotating about an axis. The receiving apparatus will be simple, but here there is one "but." The errors in measuring angles, as a result of the variable intensity of the radiation during the period of exciter rotation, will be considerable. In order to reduce these errors use is made of four fixed exciters which are arranged symmetrically near the focus of the dish and which are joined together (see photograph) [not reproduced here]. We obtain four symmetrically arranged directional diagrams. Comparing two groups of signals in pairs, a four-channel detector controls the antenna and does so separately for the azimuth and angle-of-elevation channels. The limiting accuracy in measuring angles is governed primarily by the mechanical characteristics of the antennas and the supporting-rotating apparatus. It varies from a few tens of seconds of angle to several minutes of angle.

The phase or interferometric method is more precise in comparison with the amplitude method. It is used when it is necessary to maintain communication with space vehicles at a considerable distance from the earth, for example, when determining the position of an interplanetary station.

The essence of the method is as follows. Assume that there are antennas of stations measuring angles at the points A and B. If the radio wave rays are assumed to be parallel, on the basis of the difference in the phases of the radio signals received by each antenna it is possible to compute the angle at which they arrived relative to the straight base line AB. Measurements with one base yield information on the possible position of a satellite on some surface of revolution -- a cone, and in a general case -- on a hyperboloid. Using a second base, such as one perpendicular to the first, this position can be made more precise. In phase systems the error in measuring angles can be reduced to several seconds of angle.

With respect to the rate of change of angles, their measurement is based on a phenomenon similar to the Doppler effect -- determination of the frequency difference of the signals arriving from the two antennas. However, the surface apparatus is quite complex. It includes radioelectronic apparatus, communication equipment and apparatus for checking the length of the base and the state of the atmosphere separated from one another by many kilometers. These unique systems are used extremely rarely in radio monitoring of an orbit. They are intended for the most part for supporting test launchings and are usually situated near the launching point.

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PROBLEMS OF ROCKET AND SPACE TECHNOLOGY

Moscow TRUDY PVATNADTSATYKH CHTENIY, POSVYASHCHENNYKH RAZRABOTKE ANUCHNOGO NASLEDIYA I RAZVITIYU IDEY K. E. TSIOLKOVSKOGO: PROBLEMY RAKETNOY I KOSMICHESKOY TEKHNIKI in Russian 1981 pp 152-153

[Table of Contents from book "Transactions of the Fifteenth Readings Devoted to the Elaboration of K. E. Tsiolkovskiy's Scientific Legacy and the Development of His Ideas: Problems of Missile and Space Technology, Kaluga, 12-15 Sep 1980, USSR Academy of Sciences, Institute of Natural History and Technology, Typography of the All-Union Association "Znaniye", 300 copies, 153 pages]

[Text] Table of Contents

In addition, at the plenary session, P. V. Tsybin's report was heard: "New Tendencies in Developing Space Transportation Systems".

This collection was prepared for press by S. V. Yefimkina, senior research assistant at the K. E. Tsiolkovskiy State Museum of the History of Space Travel.

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QUASISTATIONARY, STABLE, CIRCULAR ARTIFICIAL EARTH SATELLITE ORBITS WITH PERIODS OF ONE DAY

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 1, Jan-Feb 82 (manuscript received 16 Jul 81) pp 3-8

LIDOV, M. L. and VASHKOV'YAK, M. A.

[Abstract] The authors investigate the 5-year evolution of geostationary satellite orbits with a period of 1 day. (Since changes in the orbital inclination and eccentricity cause a slow drift in the orbit's actual course over the Earth's surface, the proper description is actually "quasi-stationary.") The problem reduces to an investigation of two parameters--the period of rotation and the geographical longitude of the ascending node--since the change in an orbit's eccentricity and the orientation of its plane can be ignored for such an interval when only an approximate analysis is being made. The authors set up an approximate model of a satellite's motion and discuss the points on the equator over which a geostationary satellite will pass as a function of the period of rotation and the orbit's ascending node. Figures 5; references 5.
[62-11746]

UDC 629.7.012.2

STABILITY OF SATELLITE-MOUNTED GYROSCOPE WITH FLEXIBLE ROTOR AXIS IN NEWTONIAN CENTRAL FORCE FIELD

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 1, Jan-Feb 82 (manuscript received 6 May 81) pp 9-18

GURIN, A. I. and DEMIN, V. G.

[Abstract] After postulating a gyroscope having the center of its cardan suspension coinciding with the center of mass of an artificial Earth satellite, the authors formulate several sets of coordinates that are used to set up equations of motion, the solutions of which describe the rotation of the

gyroscope's rotor and the steady-state motion of the gyroscope itself. They then derive the sufficient conditions for stability of the steady-state motion of a gyroscope with an elastic rotor axis on board a satellite for several axis orientations. Figures 4; references 4.
[62-11746]

UDC 629.191

DEPENDENCE ON TIME OF EVOLUTIONARY MOTION OF ROTATING, MAGNETIZED SATELLITE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 1, Jan-Feb 82 (manuscript received 28 Jan 81) pp 19-29

SADOV, Yu. A.

[Abstract] The author integrates a satellite's evolutionary system of motion for the purpose of demonstrating the clearcut dependence on time of the values describing the position of the vector of the satellite's kinetic moment in an absolute system of coordinates. He sets up the equations of motion, integrates them and solves them for simple special cases and the general case, then discusses the application of the theory of elliptical functions to this problem. Figures 2; references 2.
[62-11746]

UDC 629.7

GYRODAMPER FOR SATELLITE WITH DUAL ROTATION

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 1, Jan-Feb 82 (manuscript received 29 Dec 80) pp 30-40

SARYCHEV, V. A., MIRER, S. A. and ISAKOV, A. V.

[Abstract] The authors attempt to simplify the equations of motion (and all subsequent calculations) for a system consisting of a satellite and a gyrodamper that is a two-stage gyroscope, the housing of which is attached to the satellite's body by a viscoelastic suspension. Utilizing the precessional theory of gyroscopes, they set up the equations of motion and discuss the cases of both rotating and nonrotating satellites. Figures 11; references 6: 4 Russian, 2 Western.
[62-11746]

UDC 629.78.015.001

USING NAVIGATIONAL SATELLITES TO REFINE PARAMETERS OF MOTION OF ORBITAL SPACECRAFT

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 1, Jan-Feb 82 (manuscript received 9 Jun 80) pp 41-47

OGARKOV, V. I. and BAKULIN, Yu. I.

[Abstract] The authors discuss the problem of determining an artificial Earth satellite's true position on the basis of measurements of its distance and radial velocity from navigation satellites. Starting with the classical formulation of the problem of measuring distance reduces to finding the point of intersection of the surface of three spheres corresponding to measurements made at three points, they use several basic assumptions to construct a simplified processing algorithm. They find that when less than three navigational satellites are used, the measurements must be made at different times. Finally, the authors set up a mathematical model to determine the accuracy of the determination of spacecraft parameters with their algorithm. Figures 4; references 3.
[62-11746]

UDC 519.4

CURRENT-VOLTAGE CHARACTERISTIC OF MOVING CYLINDRICAL PROBE IN PRESENCE OF PHOTOELECTRIC CURRENT

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 1, Jan-Feb 82 (manuscript received 29 Sep 80) pp 65-72

IOKHANING, D. and MOSKALENKO, A. M.

[Abstract] Assuming a cylinder of infinite length moving through a rarefied plasma, with all characteristic dimensions (including radius) being small in comparison with the mean free path of the particles, the authors discuss the problem of determining the size of the flow of photoelectrons (caused by solar illumination) per unit of length of the cylinder's surface and its effect on the current-voltage characteristic. After formulating the problem and deriving expressions for the size of the flow of photoelectrons, they apply them to the probe of the "Intercosmos-10" satellite and several theoretical cases. Figures 4; references 13: 5 Russian, 8 Western.
[62-11746]

UDC 522.1:523.14

PRECISION SPACE RADIOTELESCOPE ANTENNA

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 1, Jan-Feb 82 (manuscript received 13 Oct 80) pp 149-151

KOSTENKO, V. I. and MATVEYENKO, L. I.

[Abstract] The authors discuss the design of a parabolic mirror antenna to be used to study the fine structure of cosmic maser radiation radio sources on the optimum wavelength of 1.35 cm. The mirror's reflecting surface can be 3-5 m in diameter and is made of 12 segments of thin AD1M aluminum alloy. Since the shape of the parabola must not vary by more than 5% of the wavelength, the authors give considerable attention to the mirror's housing and the problem of thermal stability (the radiotelescope will be subjected to temperatures of -150 to +150°C in space). Figures 3; references 3. [62-11746]

UDC 629.7

EFFECT OF DISSIPATIVE MAGNETIC MOMENT ON GRAVITATIONAL ORIENTATION OF ROTATING SATELLITE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 2, Mar-Apr 82 (manuscript received 29 Dec 80) pp 177-183

SARYCHEV, V. A. and SAZONOV, V. V.

[Abstract] This is essentially a continuation of an earlier study by the authors ("Gravitational Orientation of a Rotating Satellite," KOSMICH. ISSLED., Vol 19, No 4, p 499, 1981), the emphasis in this new paper being on a determination of the influence of the dissipative magnetic moment on such orientation. This problem is examined here for the case of uniaxial gravitational orientation of a satellite close to dynamically symmetric. The nominal unperturbed motion used is its periodic rotation close to stationary rotation of an axisymmetric satellite such as is required for uniform illumination by the sun at the same time that the longitudinal axis is oriented on the earth. A special control system is used for satellite orientation and then cut out. As time passes, the external dissipative moments reduce the angular velocity of rotation to a point where the control system must reaccelerate the vehicle. It is further stipulated that this must be possible for high orbits and for massive satellites of metallic construction. In this case it is the moment created by eddy currents in the satellite's skin by the earth's magnetic field which is most important. With these considerations taken into account, the authors evaluate the effectiveness of this orientation scheme with calculations of the energy expenditures required for restoration of the required angular velocity as needed. This necessitated computations, in turn, of the specific decrease

in its angular velocity under the influence of the dissipative moment of eddy currents. An example of such computations is given. Figures 1; references: 6 Russian.
[85-5303]

UDC 629.782

ACCURACY IN SOLVING KINEMATIC EQUATIONS, PART 1: ERROR EQUATION

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 2, Mar-Apr 82 (manuscript received 20 Apr 81) pp 184-190

BRANETS, V. N.

[Abstract] The author examines the problems involved in determining the accuracy in solving kinematic equations for different methods for obtaining such solutions. This is a matter of practical importance in the control of motion, especially in constructing nonplatform inertial systems. Accordingly, an attempt was made to define a quite general approach to investigation of the accuracy in solving kinematic equations. The examined kinematic equation is examined in quaternion form (see V. N. Branets, et al., PRIMENENIYE KVATERNIONOV V ZADACHAKH ORIYENTATSII TVERDOGO TELA (Application of Quaternions in Solidy-Body Orientation Problems), Moscow, Nauka, 1973). The kinematic equation used as an illustrative example is the representation of the angular velocity of motion ϖ. The accuracy in solving the equation is dependent on the method for obtaining the solution. The error equation is obtained in three forms. All these are essentially equally valid. The error in solution of a kinematic equation can be divided into two components: one of these distorts the quaternion and the second leads to a position error. The quaternion distortion is quite easy to correct. The position error causes a deviation of the computed base from the true base and is particularly important in investigating the accuracy in solving kinematic equations. Examination of solution of the error equation in its three possible forms indicated that the error is caused by the value $\delta\overline{\varpi}_E$, the difference between the angular velocity $\overline{\varpi}_E$, used in solving the kinematic equation and the angular velocity $\overline{\varpi}_E$ corresponding to the true motion. This $\delta\overline{\varpi}_E$ value can be determined as the error in primary information on the angular velocity value obtained from the angular velocity sensors. It is shown that all the sources of errors in obtaining a solution of the kinematic equations can be reduced to the equivalent error in primary information. Figures 3; references: 5 Russian.
[85-5303]

UDC 629.78.015.001

QUALITATIVE INVESTIGATION OF MOTION OF SPACE VEHICLE WITH CONSTANT RADIAL ACCELERATION

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 2, Mar-Apr 82 (manuscript received 13 Oct 80) pp 191-195

IVANOV, V. A.

[Abstract] The analysis of the controllable motion of a space vehicle with a constant radial acceleration has remained inadequate; it has not been possible to form a full idea concerning the possible trajectories of a vehicle with different initial conditions and accelerations. In this article the problem is clarified on the basis of the qualitative theory of dynamic systems (Andronov, A. A., et al., KACHESTVENNAYA TEORIYA DINAMICHESKIKH SISTEM VTOROGO PORYADKA, Moscow, Nauka, 1966; TEORIYA BIFURKATSIY DINAMICHESKIKH SISTEM NA PLOSKOSTI, Moscow, Nauka, 1967). Two systems of equations are derived which make it possible to establish all the possible regimes of motion of a space vehicle with a constant radial controlling acceleration and to determine the conditions for their use in implementing different schemes of orbital maneuvers with small thrust. The states of equilibrium in the better of these systems correspond to motions in circles with velocities different from circular for stipulated altitudes. Depending on the parameters, the velocity will be greater than or less than circular. In the first case there will be one state of equilibrium, and in the second case two. Therefore, with each value of the controlling acceleration there can be one or two different circular trajectories of the space vehicle. A table gives the results of computations of the coordinates of the states of equilibrium for different values of the dimensionless controlling acceleration and the radii of the corresponding circular trajectories. The considered regime of motion of space vehicles in a circle with a velocity different from circular can be used in performing the maneuver of bypassing a system of space objects moving in some circular orbit. As an example, the article examines the problem of the bypassing of a system of space objects in a geostationary orbit. The general approach makes it possible to determine all possible regimes of motion with a small radial thrust and to evaluate their stability. Figures 2; tables 1; references: 3 Russian.
[85-5303]

UDC 629.78

OPTIMUM CONTROL OF SPACE VEHICLE BY COMBINED METHOD DURING ENTRY INTO ORBIT AS JOVIAN ARTIFICIAL SATELLITE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 2, Mar-Apr 82 (manuscript received 2 Mar 81) pp 211-226

IVANOV, N. M., MARTYNOV, A. I. and SOKOLOV, N. L.

[Abstract] Using a standard approach it is virtually impossible to create a Jovian artificial satellite. This dictates using the so-called "combined" method, which provides a significant energy advantage in comparison with the active method. In this method the vehicle moves in a hyperbolic trajectory and enters the dense layers of the atmosphere at a stipulated velocity and inclination. Aerodynamic braking occurs in the upper layers of the atmosphere and after emergence from the atmosphere the vehicle moves in a transitional ellipse with an apocenter altitude $h_{\alpha 1}$ and a pericenter altitude $h_{\pi 1}<h_a$, where h_a is the nominal boundary of the dense layers of the atmosphere. The motion of the vehicle from this orbit to the desired orbit occurs by a single thrust at the transitional orbit apocenter. The necessary energy expenditures will be the less the greater the vehicle's velocity at the apocenter of the transitional orbit. This can be achieved by optimum control in the segment of preliminary aerodynamic braking. The combined method requires solution of a number of complex problems. It is necessary to ensure a high navigation accuracy in the approach segment in order to effect a precise entry of the vehicle into the required corridor. It is necessary to create a special vehicle capable of operating both in the exoatmospheric flight segment and in the segment of transit through the dense layers of the atmosphere. A reliable heat insulation system is mandatory. There must be a control system operating reliably in the different segments. The authors here emphasize two main problems involved in creating a Jovian satellite by the combined method. 1) Search for optimum control in the atmospheric segment from the condition of minimizing the energy expenditures in forming the Jovian satellite orbit by an active impulse at the apocenter of the transitional orbit and the finding of the optimum trajectories and the corresponding optimum control minimizing the required weight of the thermal shielding. It is shown that Jovian satellites can be put into orbit at altitudes 20,000-40,000 kilometers above the surface. Although the weight of the vehicle heat shielding may attain 30-40% of the vehicle weight, nevertheless the forming of Jovian satellite orbits by the combined method is characterized by a quite high energy efficiency since the fuel expenditures in many cases do not exceed 10-15% of the vehicle weight, that is, the total expenditures will not exceed about 50% of the vehicle weight, whereas for the purely rocket dynamic method the fuel expenditures are 90% of the vehicle weight. When using the combined method the greatest energy advantage is observed during motion of the vehicle near the upper boundary of the corridor. Numerical and graphic results of computations are given for a wide range of entry conditions. Variational problems are solved for minimizing the energy expenditures required for putting a satellite into orbit, minimizing the total heat flows and maximum temperature at the critical point. Figures 10; 8 Russian, 2 Western.
[85-5303]

UDC 629.7

EVALUATION OF INFLUENCE OF DISSIPATIVE MAGNETIC MOMENT OF EDDY CURRENTS ON RAPID SATELLITE ROTATION

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 2, Mar-Apr 82 (manuscript received 10 Mar 81) pp 297-300

SARYCHEV, V. A. and SAZONOV, V. V.

[Abstract] It is easiest to maintain a satellite in orbit in a stand-by state by ensuring it the capability of free motion relative to its center of mass. However, it will be overheated if it remains too long with only one side turned toward the sun. This danger can be overcome by providing for rapid rotation relative to two noncollinear axes. Regular Euler precession can be used as such motion for an axisymmetric satellite. A special control system can ensure such precession parameters at the initial time; then the control system is cut out. After some time the satellite may again deviate from the required parameters, a situation which can be rectified by reactivation of the control system. All this requires computations of satellite rotational motion. Accordingly, the authors propose one method for such computations based on evaluations of solutions of the averaged equations of motion. In the case of high orbits and massive metal satellites the most important factors determining the evolution of rotational motion are orbital regression, gravitational moment and dissipative moment of the eddy currents induced in the satellite shell by the earth's magnetic field; only the dissipative moment is analyzed in this article. The solution is obtained with the following assumptions: the satellite orbit is circular and fixed in absolute space and the satellite is acted upon only by the dissipative magnetic moment of eddy currents. Computations are made with stipulated parameters. Formulas are given for the angular velocity of precession and the angular velocity of rotation. Figures 2; references: 1 Russian.
[85-5303]

UDC 666.11.01:536.6

TEMPERATURE MEASUREMENTS FOR PRODUCING GLASS UNDER MICROGRAVITATION CONDITIONS

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 4, Apr 82 pp 45-48

PETROVSKIY, G. T., OLEYNIK, B. N., AMBROK, G. S., SEMESHKIN, I. V. and SUMERIN, V. M.

[Abstract] Precise temperature measurements are essential in the production of such materials as glass in space. Ordinary methods employed under ordinary gravitational conditions are inapplicable; highly precise, high-speed measurement-computation complexes are required. This article describes the principal methods for measuring the glass melt, the errors which can arise and the ways to reduce them, and the block diagram for a measurement-computation complex for monitoring and regulating temperature in glass production under microgravitation conditions. Thermoelectric thermometers and radiation pyrometers are discussed; both instrumental and methodological errors are analyzed. The electromagnetic interference and vibrations which may affect the readings must be totally eliminated. With respect to methodological errors, the most important are those associated with radiative heat exchange. In the proposed measurement-computation complex the data received from the heated object is transformed by thermoelectric or pyrometric transducers into an electric signal which is fed to a measurement transducer which is a linear converter. An analog signal from the measurement transducer is fed through an analog-digital converter into a digital computer for further nonlinear statistical processing, the introduction of a correction and output of a control signal to the heating unit, measurement transducer and analog-digital converter. This scheme ensures a means for correcting the time drift of the temperature transducers and correction of the methodological error and performs a wide range of other essential functions as well. The complex yields reliable data on the physicochemical processes in the glass and crystal melts under microgravitation conditions, a vital requirement for developing equipment and procedures for producing optical materials. Figures 2; tables 2; references: 9 Russian.
[92-5303]

SPACE GLACIOLOGY

Moscow ZEMLYA I VSELENNAYA in Russian No 6, Nov-Dec 81 pp 7-13

DESINOV, L. V.

[Abstract] The remoteness of such regions as Antarctica and the Arctic, as well as many mountain ranges, make it imperative that their glaciers and ice cover be studied from the vantage of space. The ever-increasing need for fresh water makes glaciology an extremely important science. In the USSR glaciological studies from space were initiated on the first "Salyut" orbital station and have continued on all subsequent manned flights. This article reviews some of the work of glaciologists at the State Center "Priroda" in collaboration with cosmonauts under the direction of V. M. Kotlyakov, corresponding member, USSR Academy of Sciences. It was Kotlyakov who some years ago proposed the organization of a service for the monitoring of snow and ice which would integrate ice observations made from space, from aircraft an on the ground. Now it is already clear that space observations make it possible to survey the pattern of snow melting and map avalanche sites in such regions as the Caucasus, Tien Shan and Altay. The glaciers of many ranges have been photographed and an amazing amount of detail has been revealed. Photographs of the ice cover on seas have made it possible to interpret the dynamics of freezing of saline sea water and map continuous ice fields, local and spiraling ice formations near islands, spot and monitor icebergs in the ocean. It has been found that large floes can be identified at distances up to 1000 km (but glaciers in narrow valleys can be studied only during flight directly over them). Successive flights over all ice and snow features make it possible to determine their temporal changes. Great masses of observational data are being accumulated. For example, countless observations now document the behavior of "pulsating" glaciers in many parts of the world. All these data will be incorporated in the Atlas of Snow and Ice Resources of the World. Figures 6.
[60-5303]

UDC 528.77(202):55(575.3)

GEOLOGICAL INTERPRETATION OF SPACE PHOTOGRAPHS OF GISSARO-ALAY RANGES

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 82 (manuscript received 18 Jun 81) pp 14-19

LAVRUSEVICH, A. I. and PYZH'YANOV, I. V., "Priroda" State Scientific Research and Production Center

[Abstract] The authors used medium-scale, integral, black-and-white space photographs in combination with a geological map on the same scale to study the geological structure of the Gissaro-Alay Ranges. After listing the types of geological formations that can be identified most reliably in space photographs, they discuss the extensive fracture-fault systems found in the

photographs, as well as the four systems of dislocations with breaks in continuity. Several ring structures were also found, ranging in size from 1-5 to 80 km in diameter, along with oval and circular sections 2-40 km in diameter. Figures 1; references 3.
[51-11746]

UDC 528.94:629.78(571.56)

SPACE PHOTOTECTONIC MAP OF YAKUT ASSR

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 82 (manuscript received 22 Jun 81) pp 25-31

BILANENKO, V. A., SHAROV, G. N. and YAN-ZHIN-SHIN, V. A., "Yakutsgeologiya" Geological Production Association

[Abstract] Using television and scanner space photographs with scales of 1:500,000,000-1:12,000,000 and space photographs with scales of 1:200,000 and 1:1,000,000-1:2,000,000, the authors helped compile a space phototectonic map of the Yakut ASSR, with a scale of 1:1,500,000, in 1980. On the map, 31 distinct blocks are distinguished, some of which have the same photographic image characteristics, although they are spatially separated. There are also lineament zones and four orders of lineaments, which are basically related to fault areas. Cones of different sizes and origins are also delineated. The map may be of use in prospecting for gold, gas and oil. Figures 3; references 12.
[51-11746]

UDC 550.34.06+551.254:629.78

APPLICABILITY OF AVALANCHE-UNSTABLE JOINT FORMATION MECHANISM IN INTERPRETATION OF SPACE PHOTOGRAPHS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 82 (manuscript received 13 Jul 81) pp 32-36

KARAKHANYAN, A. S. and MIKAYELYAN, A. O., Institute of Geological Sciences, Armenian SSR Academy of Sciences, Yerevan

[Abstract] After describing the main features and stages of the avalanche-unstable joint formation mechanism, the authors attempt to relate it to the area around the southern half of the Caspian Sea, which they divide into two regions on the basis of the density and nature of the distribution of seismically active lineaments. They conclude that there is, in principle, a possibility of using an avalanche-unstable joint formation model to explain the rules governing the spatial distribution of seismically active lineaments seen in space photographs, and that the utilization of the theory of

avalanche-unstable joint formation for large regions may make it possible to predict the development of joint formation processes and rock mass movements. Figures 1; references 11.
[51-11746]

UDC 551.326.85:629.78

EVALUATING ACCURACY OF MAPPING OF ICE SITUATION ON LARGE LAKES WITH SPACE TELEVISION PHOTOGRAPHS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 82 (manuscript received 10 Mar 81) pp 37-40

PROKACHEVA, V. G. and ZVEREVA, V. M., State Hydrological Institute, Leningrad

[Abstract] The authors investigated ice situation mapping for Lakes Baykal, Ladoga and Onega, using ice maps based on synchronous and quasisynchronous aerial reconnaissance data and television images obtained by low- and medium-resolution systems on board "Meteor" artificial Earth satellites. For 14 cases, the television images' error relative to the aerial reconnaissance data was 8%. The authors conclude that for lakes larger than 9,000 km^2, the ice situation can be mapped from satellite television images with a degree of detail comparable to mapping based on aerial reconnaissance data. Figures 3; references 2.
[51-11746]

UDC 681.3:528

RAPID BAYES' CLASSIFICATION OF MULTISPECTRAL IMAGES

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 82 (manuscript received 27 Aug 81) pp 52-59

MINSKIY, D. Ye. and CHIZHEVSKIY, A. M., Special Department for Research and Investigation, All-Union "Soyuzgiprovodkhoz" Institute, Moscow

[Abstract] The authors present an algorithm for the two-stage computer identification of objects in multispectral video images that they claim has the advantage of being both accurate and rapid. After setting up a decision rule and explaining the principle of two-stage identification on the basis of an analysis of correlation matrices, they discuss the choice of the system of identification features and its effect on accuracy. Finally, they describe the step-by-step functioning of the algorith, which is written in FORTRAN-80. References 13: 11 Russian, 2 Western.
[51-11746]

UDC 634.4:629.78

USING DIGITAL INFORMATION TO INTERPRET SOIL AND VEGETATIVE COVER

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 82
(manuscript received 17 Mar 81) pp 68-73

VASIL'YEV, L. N., Institute of Geography, USSR Academy of Sciences, Moscow

[Abstract] Using multispectral aerospace surveying materials and the "expanding window" method (the combination of small "windows" covering a uniform area into a large one, as long as the condition of uniformity is maintained), the author attempts to find a method for identifying soil and vegetative cover features in a semidesert and a dry steppe area. The method he developed has been used successfully for soil mapping in the Kalmyk ASSR. Figures 6; references 6: 5 Russian, 1 Western.
[51-11746]

UDC 502.3:629.78

DIGITAL FILTRATION OF LINEAMENT GRIDS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 82
(manuscript received 10 Mar 81) pp 74-80

SMIRNOV, M. V., All-Union Institute of Geological Prospecting for Petroleum, Leningrad

[Abstract] The solution to the problem of digital processing of lineament maps involves: 1) determining the anisotropy and primary directions in the angular distribution of lineaments in an image; 2) distinguishing the linear elements in the primary direction, as well as lines running in an arbitrary direction; 3) constructing maps of lineament distribution density per unit of area. The author discusses each of these aspects and proposes methods for accomplishing them that are based largely on Fourier transforms. Figures 6; references 13: 12 Russian, 1 Western.
[51-11746]

UDC 551.46:528.7

DIFFERENTIAL METHOD FOR REMOTE SENSING OF EARTH'S ATMOSPHERE ALONG DERIVATIVE LIMB RADIANCE PROFILES

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 82 (manuscript received 22 Jan 81) pp 95-101

TROFIMOV, Ye. M. and ALMAZOV, S. I., State Scientific Research Center for the Study of Natural Resources, Moscow

[Abstract] The authors propose a method for solving the problem of finding the derivative of the atmosphere's brightness profile as measured from a satellite. Their polyharmonic method involves using a series of harmonics, the number of which depends on the requirements of the problem and the measuring system's quality. They conclude that this method has more potential than the one based on the interpretation of direct radiation measurements. References 16: 3 Russian, 13 Western.
[51-11746]

UDC 629.19.551

ONE CLASS OF ORBITS FOR ACCELERATED VIEWING OF EARTH'S SURFACE

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 82 (manuscript received 11 May 81) pp 116-121

LUKASHEVICH, Ye. L. and SAUL'SKIY, V. K.

[Abstract] The authors state that in order to insure discrete sensing of the Earth's surface with diurnal and nocturnal spacecraft viewing bands, there is a condition that must be satisfied in addition to that of quasi-geosynchronicity of motion, which is necessary in order to achieve periodic, complete viewing of the covered areas. This condition is that the intersection of the subsets formed by the rising nodes of an orbit on any interorbital interval of arbitrary length L with the subsets formed by the orbit's descending nodes on the same interorbital interval be empty for the first L/2x days (x = displacement of the flight track after k days for a k-fold orbit). This additional condition can be satisfied by any even-ordered ones with even multiplicity factors. The authors set up the mathematical apparatus for determining the optimum parameters from this rather extensive set. Figures 2; references 3.
[51-11746]

UDC 631.1:629.78

REGRESSION ANALYSIS OF REMOTE MEASUREMENT DATA AND PARAMETERS OF STATE OF NATURAL FORMATIONS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 82 (manuscript received 27 May 81) pp 122-124

KLIMENKO, O. Ya. and KOZODEROV, V. V., State Scientific Research Center for the Study of Natural Resources, Moscow

[Abstract] Determining the parameters of state of natural objects according to their spectral brightnesses is a basic problem of remote sensing that will probably not be solved in the near future, but regression analysis--in which the problem reduces to determining the coefficients of linear equations on the basis of integrated aerospace and ground measurements--can be used to find the most stable of these relationships. The authors explain the algorithm they have developed for this purpose, give an example of its use, and conclude that it is quite possible, in principle, to use the step regression method to find the most essential relationships between the brightness characteristics of agricultural objects and their parameters of state. References 3.
[51-11746]

UDC 502.3:629.782

PREPARATION FOR AND CONDUCT OF COMPLEX OF EXPERIMENTAL INVESTIGATIONS OF ENVIRONMENT WITH HELP OF COSMONAUTS FROM SOCIALIST COUNTRIES

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 82 (manuscript received 13 Oct 81) pp 11-19

KOVAL', A. D. and VEDESHIN, L. A., "Priroda" State Scientific Research and Production Center, "Intercosmos" Council, USSR Academy of Sciences

[Abstract] The authors give an overall summary of the complex of experimental observations carried out by the international crews on the "Salyut-6" station in accordance with the "Intercosmos" program in 1978-1980. After listing the general goals of the program and the equipment used, they give a brief description of the specific goals of each experiment and, in very general form, the basic results achieved. Figures 6.
[80-11746]

UDC 551.24:629.78(497.2)

LARGEST LINEAMENTS AND RING STRUCTURES IN TERRITORY OF BULGARIA

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 82
(manuscript received 22 Jun 81) pp 20-24

GOCHEV, P. M., KATSKOV, N. K. and SPIRIDONOV, Kh. B., Geological Institute, Bulgarian Academy of Sciences, Sofia; Geological-Geophysical Enterprise, Ministry of Geology, People's Republic of Bulgaria, Sofia; Central Laboratory of Space Research, Bulgarian Academy of Sciences, Sofia

[Abstract] Using space photos taken by an ERTS (1972-1974) and a "Meteor" (1974-1975) satellite, the authors study the system of lineaments and ring structures in Bulgaria that can be detected in them. The lineaments are divided into two groups: those that coincide completely or partially with known fracture structures and those that do not. Only the largest ring structures are distinguished, since investigators' opinions about them vary considerably. Several previously unknown lineaments, which require further study, are found. The authors conclude that more varied types of space photographs are needed for future work and that one goal of it should be the determination of the metallogenic value of ring structures. Figures 1; references 16: 12 Russian, 4 Western.
[80-11746]

UDC 551.24:629.78(430.2)

LINEAMENTS IN TERRITORY OF GDR

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 82
(manuscript received 22 Jun 81) pp 25-26

BANKWITZ, P., BANKWITZ, E. and FRISCHBUTTER, A., Central Institute of Physics of the Earth, GDR Academy of Sciences, Potsdam

[Abstract] A lineament map of the GDR, on a scale of 1:2,500,000 has been compiled on the basis of space photographs taken in the 500-1,000 nm band of the spectrum. The majority of the lineaments have a northwest-southeast or northeast-southwest strike, which the authors attempt to correlate with geophysical features. Large lineament zones lie 60-80 km apart, although the smallest separation is 10 km. Figures 1.
[80-11746]

UDC 550.814:629.78(729.1)

EXPERIMENT IN USING MULTISPECTRAL AEROSPACE PHOTOGRAPHS IN GEOLOGICAL INVESTIGATIONS IN CUBA

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 82 (manuscript reeeived 22 Jun 81) pp 27-40

AL'BEAR, Kh. F., MAKAROV, V. I., BAGINYAN, M. K. and TELEGIN, V. P., Institute of Geology and Palenontology, Cuban Academy of Sciences, Havana; Geological Institute, USSR Academy of Sciences, Moscow; USSR Ministry of Geology

[Abstract] The "Tropik-1" experiment was formulated to determine the feasibility of using multispectral surveying to study natural resources under the conditions encountered in the moist tropics and subtropics. Using aerial photographs taken in the 0.47-, 0.55-, 0.66-, 0.70- and 0.82-μm bands, on a 1:50,000 scale and encompassing areas measuring 3.5 x 4 km, in combination with multispectral space photographs, the authors attempt to identify both single- and multicomponent objects. They list the discernible geological objects by type and conclude that under conditions of almo t solid agricultural cover, space photographs are of much more value in detecting geological formations such as lineaments. Figures 5; references 2.
[80-11746]

UDC 528.7;91+551.462+551.482.6

FIRST RESULTS OF RESEARCH IN USING MULTISPECTRAL AEROSPACE SURVEYING IN GEOGRAPHIC INVESTIGATIONS IN CUBA

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 82 (manuscript received 1 Oct 81) pp 41-47

ASOYAN, D. S., KRASNOZHON, G. F., SALTANKIN, V. P., BERDEYANS, D., RIVERO, F., PEREZ, W., PORTELA, A. and MORA, N., Institute of Geography, USSR Academy of Sciences, Moscow; Institute of Water Problems, USSR Academy of Sciences, Moscow; Institute of Technical Fundamental Research, Republic of Cuba Academy of Sciences, Havana; Institute of Geography, Republic of Cuba Academy of Sciences, Havana; Institute of Hydroeconomics, Havana

[Abstract] This experiment was conducted to determine the feasibility of using multispectral, black-and-white and color, synthesized aerospace photographs to solve geomorphological and hydrological problems under the conditions encountered in the tropics. Using aerial photographs taken in six spectral bands and space photographs (origin unspecified), the authors discuss their utility for studying land and shelf areas in two testing grounds (Havana-Matanzas and Pinar del Rio). The goals, techniques and results are discussed in general form and the most promising areas for continued research are listed. Figures 1; references 8: 6 Russian, 2 Western.
[80-11746]

UDC 551.24:629.78(517.3)

LINEAMENTS AND RING FORMATIONS IN TERRITORY OF MONGOLIA

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 82 (manuscript received 22 Jun 81) pp 48-54

KHOSBAYAR, P., Geological Institute, Mongolian People's Republic Academy of Sciences, Ulan-Bator

[Abstract] A map of lineaments and ring formations in the Mongolian People's Republic has been compiled, on a scale of 1:2,500,000, on the basis of scanner observations made with the "Meteor" series of satellites and "Landsat-1" at different times. Image shading plays a large part in the discrimination of geological objects in this area. The author discusses in detail both types of features, noting that several previously unknown systems of dislocations with breaks in continuity have been detected, whereas all the five groups of ring structures found are new (not even high-altitude aerial surveying has been done in this area). Figures 1; references 4.
[80-11746]

UDC 528.77:629.78(517.3)

EXPERIMENT IN INTEGRATED MAPPING OF MONGOLIA'S RESOURCES, BASED ON SPACE INFORMATION

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 82 (manuscript received 26 Nov 81) pp 55-59

KASHIN, L. A., KIYENKO, Yu. P., KEL'NER, Yu. G., SANZHAAZHAMTS, Zh. and SAANDAR', M., "Priroda" State Scientific Research and Production Center; State Administration for Geodesy and Cartography, Construction and Architectural Commission, Council of Ministers, Mongolian People's Republic

[Abstract] In order to study the Mongolian People's Republic's natural resources, space information was used to compile a series of thematic maps on a scale of 1:1,000,000; the work was completed in 1981. The themes of the maps are: geological structure, with neotectonic elements; average multiyear drainage of surface and subterranean waters; land resources, soil use; fodder and botany; forest resources; topography and typological zoning. The authors explain the practical utility of these maps.
[80-11746]

UDC 551.24:629.78(47+57)

SOME GENERAL QUESTIONS ON METHODOLOGY, AND RESULTS OF STUDYING LINEAMENTS AND RING FORMATIONS ON USSR TERRITORY

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 82 (manuscript received 22 Jun 81) pp 60-69

MAKAROV, V. I. and STREL'NIKOV, S. I., Institute of Geology, USSR Academy of Sciences, Moscow; All-Union Geological Institute, Leningrad

[Abstract] The authors give separate overall reviews of what has been accomplished in the study of lineaments and ring formations on USSR territory. As far as lineaments are concerned, their study is barely (if at all) beyond the analysis stage, with the cataloguing of parameters still being done. Thus, no real classification can yet be made. In addition, it is still impossible to explain the seeming orderliness of the main lineament strikes in the USSR, although they are neotectonic in nature and must be related to the neotectonic structure. The situation of ring formations is slightly more advanced, since there has been some genetic classification of them. References 30: 29 Russian, 1 Western.
[80-11746]

UDC 551.24:629.78(437)

TERRITORY OF CZECHOSLOVAKIA AS EXAMPLE OF INTERPRETING PLANETARY FAULT SYSTEM WITH HELP OF SPACE PHOTOGRAPHS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 82 (manuscript received 22 Jun 81) pp 70-73

KVET, R., Geography Institute, Czechoslovakian SSR Academy of Sciences, Brno

[Abstract] There appear to exist planetary systems (of different ages) of geometrically identical networks of fracture zones or fractures located equidistant from each other. The author's theory of such systems is that they are networks of fracture zones and faults that were formed periodically after the culminations of the main orogeneses, have a common genesis, and are oriented regularly relative to the Earth's figure of revolution. Using space photographs taken from Soviet and American satellites, he finds nothing to refute this theory but says that much more work is needed on the subject, preferably with large-scale images encompassing large territories. Figures 1; references 10: 1 Russian, 9 Western.
[80-11746]

UDC 528.7:91+551.162+551.482.6

USING SPACE INFORMATION IN INVESTIGATIONS OF CONTINENTAL WATER RESOURCES

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 82
(manuscript received 24 Jun 81) pp 74-77

GAL'PERIN, I. M., DZHAMALOV, R. G., KRASNOZHON, G. F., MUZYLEV, Ye. L., OB"YEDKOV, Yu. L. and SALTANKIN, V. P., Institute of Water Problems, USSR Academy of Sciences, Moscow

[Abstract] In 1975, the Institute of Water Problems began a resource evaluation program that had as its goals the determination of the most informative wavelengths for multispectral space surveying, the development of techniques for interpreting space photographs, and the discovery of the interpretable features of different water objects, processes and phenomena. This resulted in the compilation of a map of the Northern Caspian coast line that is of practical interest to several ministries. Similar maps have now been compiled for the Fergana Valley, central Mongolia and sections of Cuba's shelf area. The authors discuss the technical requirements for the space information and some of the techniques used.
[80-11746]

UDC 528.7;91+551.162+551.482.6

USING SATELLITE INFORMATION TO PREDICT VOLUME OF SPRING HIGH WATER, ON EXAMPLE OF CHARA RIVER

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 82
(manuscript received 8 Oct 81) pp 78-82

PROKACHEVA, V. G. and CHMUTOVA, N. P., State Hydrological Institute, Leningrad

[Abstract] The authors attempt to use 8-10 years worth of space photographs to search for relationships among the three basic high water characteristics: depth of the runoff layer at high water, average monthly water flow rate, and runoff volume during the remaining part of the high water period. Their area of investigation is the Chara River, in the Stanovoye upland, which has a drainage system 4,150 km^2. Half the system is an intermountain basin at heights of 700-1,200 m, with the framing mountains reaching a height of 3,000 m. They conclude, on the basis of a 2-year check of the relationships they postulated, that satellite information can be used to predict melt runoff with a lead time of 1-1.5 months, although there are as yet many limitations on its utility. Figures 4; references 7: 6 Russian, 1 Western.
[80-11746]

UDC 631.4:629.78

TECHNIQUES FOR INTERPRETING SOIL EROSION FROM REMOTE SENSING MATERIALS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 82 (manuscript received 5 Dec 81) pp 92-95

STEGLIK, O., Institute of Geography, Czechoslovakian SSR Academy of Sciences, Brno

[Abstract] By using multispectral photographs taken in six bands (500, 530, 550, 620, 700 and 800 nm) at an altitude of 4,400 m, and comparing the optical densities of different bands with the soil erosion pattern in a field, as determined from moving pictures taken at an altitude of 200 m, the author attempts to determine the suitability of multispectral surveying to evaluate soil erosion. Different bands prove to be better for eroded areas and areas where eroded material accumulates. The author also attempts to extend this to the utilization of multispectral space photographs and concludes that it can be done, but that aerospace information needs to be combined with ground specttometric measurements. Figures 2; references 1.
[80-11746]

UDC 528.7:91

IMPROVING REMOTE SENSING TECHNIQUES FOR GEOGRAPHICAL PURPOSES

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 82 (manuscript received 2 Oct 81) pp 101-106

VASIL'YEV, L. N., Institute of Geography, USSR Academy of Sciences, Moscow

[Abstract] Remote (aerospace) sensing methods for geographical purposes can be used both for thematic mapping and the study of geosystems, the latter of which cannot be done by traditional methods. Aerial photography is probably more suitable for the compilation of land use maps, since the scale of space photographs is too large. As far as the study of geosystems is concerned, the interpretation of measurements is primarily qualitative in nature. The author also discusses in detail the use of the method of main components in the interpretation of multispectral space photographs. Figures 2; references 11: 5 Russian, 6 Western.
[80-11746]

UDC 528.7:629.78

OPTICOPHOTOGRAPHIC METHOD FOR VIDEO PROCESSING OF DATA GATHERED DURING REMOTE INVESTIGATIONS OF EARTH

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 82 (manuscript received 29 Dec 81) pp 115-122

KROITZSCH, V. and FRUBRICH, M., Central Institute of Physics of the Earth, GDR Academy of Sciences, Berlin

[Abstract] The authors define "opticophotographic methods" as being photographic methods from opticoanalog technology and state that they can be used to supplement digital video data processing methods. The primary purpose for using these methods is to prepare photographic images for visual interpretation; that is, to perform analog-to-photograph transformations. The authors discuss the use of these methods in examples of threshold formation, transformation by quantization, and arithmetic transformation. They also discuss equidensitometric processing, and compare discrete (digital) and analog (photographic) processing. They conclude that: 1) the high resolution offered by photogrammetry makes it a necessary took in video data processing; 2) opticophotographic video processing is advantageous when the primary information is a photographic image; 3) it can sometimes be used instead of electronic-digital video processing, which requires expensive equipment; 4) only the most basic beginnings have been made in this area. Figures 8; references: 8 Western.
[80-11746]

UDC 582.72

ADAPTIVE DELTA MODULATOR FOR MULTISPECTRAL VIDEO DATA

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 82 (manuscript received 9 Feb 81) pp 123-130

MISHEV, D. N. and PETROV, P. V., Central Space Research Laboratory, Bulgarian Academy of Sciences, Sofia

[Abstract] The authors propose an adaptive delta modulation algorithm for compressing data gathered during thematic flights for the purpose of conducting a remote investigation of the Earth, which is quite useful for the study of slowing changing sections. The algorithm's component parts are Song's adaptive delta modulation method with overshoot suppression and a method for asynchronous delta modulation with a variable quantification step. It also features an overshoot suppression engagement threshold and a method for smoothing out irregularities that are of no interest. The authors also describe the equipment used to realize the algorithm. Figures 5; references 12: 5 Russian, 7 Western.
[80-11746]

UDC 629.195:550.8

GEOLOGICAL RESULTS OF VISUAL OBSERVATIONS FROM 'SALYUT-6' STATION

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEOLOGIYA I RAZVEDKA in Russian No 3, Mar 82 pp 8-13

POPOV, L. I., RYUMIN, V. V., KOZLOV, V. V., BUSH, V. A., BOGORODSKIY, S. M., KOZLOV, V. A., ROMASHOV, A. A. and SULIDI-KONDRAT'YEV, Ye. D., "Aerogeologiya" PGO

[Abstract] The authors give a preliminary report on the program of visual observations of geological formations by the fourth crew (L. I. Popov and V. V. Ryumin) on the "Salyut-6" orbital station. The observations were made at different times of the year and day and from different angles; linear and ring structures were the formations primarily observed. The authors discuss in detail the structural elements seen in three areas: the northern pre-Caspian, central and southern Kazakhstan and the western end of the Mediterranean Sea. Figures 3; references 6.
[77-11746]

UDC 629.195;551.24(571.651)

PRINCIPAL FAULTS IN NORTHERN PART OF OKHOTSK-CHUKOTSK VOLCANOGENIC BELT, AS DETERMINED FROM SPACE PHOTOGRAPHS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEOLOGIYA I RAZVEDKA in Russian No 3, Mar 82 pp 22-29

FILATOVA, N. I., DVORYANKIN, A. I., DOROGUTIN, A. P., KUZNETSOVA, I. A., MAZHENSHTEYN, F. A. and SMELOVSKAYA, M. M., "Aerogeologiya" PGO

[Abstract] On the whole, small-scale space photographs of the Okhotsk-Chukotsk volcanogenic belt reveal a complex system of regularly connecting, rectilinear dislocations with breaks in continuity, having a predominantly northeasterly orientation, along which there are tectonomagmatic ring structures that are quite close to gether in some places. The degree of clarity with which these discontinuities appear in such photographs depends largely on the lineament's magmatic activity in the Mesozoic Era. The authors discuss vertical and steeply slanting faults with diagonal and orthogonal dislocations with breaks in continuity and tilted faults. They conclude that the use of small-scale space photographs is of assistance in determining the locations of large-scale discontinuities. Figures 1; references 8.
[77-11746]

UDC 551.24:528.77:629.195(47-12)

USING SPACE INFORMATION IN COMPILATION OF TECTONIC MAP OF PRE-CASPIAN DEPRESSION AND ITS FRAMING, ARTICLE 2: PROBLEM OF MULTILEVEL GEOLOGICAL INTERPRETATION

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEOLOGIYA I RAZVEDKA in Russian No 3, Mar 82 pp 36-44

KAPUSTIN, I. N., PRZHIYALGOVSKIY, Ye. S., TROFIMOV, D. M. and VOLCHEGURSKIY, L. F., All-Union Petroleum Scientific Research Institute of Geological Exploration; Moscow State University imeni M. V. Lomonosov, "Aerogeologiya" PGO

[Abstract] The authors state that the depth of occurrence of geological objects cannot be determined from space photographs alone, but that geological and geophysical data characterizing different structural and formational complexes lying at different depths must be used in conjunction with them. They use as an example of this the manifestation of lineaments at different levels of the platform mantle and foundation, with the goal being to determine the correctness of placing them in the category of rupture dislocations. Figures 1.
[77-11746]

UDC 629.195:551.24(571.14)

SOME REGULARITIES IN ARRANGEMENT OF DISLOCATIONS WITH BREAKS IN CONTINUITY IN PRE-CASPIAN DEPRESSION, BASED ON DATA FROM INTERPRETATION OF SPACE PHOTOGRAPHS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEOLOGIYA I RAZVEDKA in Russian No 3, Mar 82 pp 45-51

VOLCHEGURSKIY, L. F. and PRONIN, V. G., "Aerogeologiya" PGO

[Abstract] The authors use space photographs to study the geology of the pre-Caspian depression. The information derived from these photographs is primarily of a tectonic nature. There is a detailed discussion of the fractures and fracture zones seen in the photographs, after which the authors compare their findings with available geological and geophysical materials. It is evident that some modifications of presently held ideas are necessary. Figures 2; references 11.
[77-11746]

UDC 629.195(553.41+553.45)

EXPERIMENT IN USING SPACE PHOTOGRAPHS TO DETECT REGULARITIES IN LOCATION OF GOLD AND TIN MINERALIZATION

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEOLOGIYA I RAZVEDKA in Russian No 3, Mar 82 pp 96-99

ARTEMOV, A. V., GED'KO, M. I. and PICHUGIN, L. P., "Aerogeologiya" PGO

[Abstract] Deep fractures, which are quite distinct in space photographs, are the most important factor in gold and tin mineralization. Using space photographs of an unidentified mining region in the USSR, the authors divide the observed fractures into three types: longitudinal (with a northwesterly strike), transverse (northeasterly strike) and diagonal (submeridional). Their analysis indicates that the most likely gold-bearing areas are to be found at intersections of longitudinal and diagonal fractures and in narrow, knee-shaped folds of longitudinal fractures. Tin ore deposits appear to be found along transverse deep fractures. References 4.
[77-11746]

UDC 551.24:555.3.239(5.011+47.13)

LINEAMENTS IN EARTH'S CRUST IN SOUTHERN USSR AND ADJACENT REGIONS OF NEAR EAST AND THEIR RELATIONSHIP TO PRESENCE OF GAS AND OIL

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEOLOGIYA I RAZVEDKA in Russian No 3, Mar 82 pp 100-106

DEMIDOV, V. A. and ROMASHOV, A. A., "Aerogeologiya" PGO

[Abstract] The authors distinguish three groups of linear formations in gas- and oil-bearing areas that can be seen in space photographs: fracture systems forming the "fracture framework" of these areas; lineament systems that require further study; linear elements that are manifestations of hidden (buried) fractures or reflections of elements of a planetary network. There are also two types of gas- and oil-bearing territories: zones of intensive warping and areas of arches, uplifts and protrusions of the basements of plates and ancient and young platforms. The authors find no clear correlation between the types of formations and the presence of gas and oil, but state that further work is needed on the subject. Figures 2; references 21: 20 Russian, 1 Western.
[77-11746]

15TH ANNIVERSARY OF 'INTERCOSMOS' NOTED

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 4, Apr 82 pp 44-45

[Article by M. Rimsha: "The Orbits of Friendship"]

[Text] The materials of the 26th CPSU Congress mentioned peaceful development of space as one of the international problems in whose solution the Soviet Union will take an active part. The article below is devoted to this subject.

This year marks 15 years of cooperation among the socialist countries in the field of the investigation and use of space. The date of the founding of the Intercosmos program is officially considered to be April 1967. It received its present name somewhat later, in 1970. At the Moscow meeting in 1967 delegations from Bulgaria, Hungary, East Germany, Cuba, Mongolia, Poland, Romania, the USSR, and Czechoslovakia discussed the principal tasks and the subject area of cooperation. It was decided to concentrate at first in four general lines of scientific study: space physics, space biology and medicine, space meteorology, and space communications. The Soviet Union offered to allow the use of their space facilities free of charge to carry out the joint scientific project. The participating countries expressed their readiness to manufacture scientific equipment to be put in the satellite without any kind of mutual financial charges. They agreed that the results obtained from the experiments would be the common property of their authors and could be presented in the form of joint publications or reports at international scientific meetings.

These were the fundamental organizing principles of cooperation among the socialist countries in space activities. These principles were put in final form on 13 July 1976 in Moscow during a meeting of governmental delegations from countries participating in the Intercosmos program. At that time an intergovernmental agreement was signed on joint investigation and use of space for peaceful purposes. In 1975 a fifth research area was added, remote sensing of the earth. The representation of countries in the Intercosmos program was also broadened. In 1979 the Socialist Republic of Vietnam became a member of this "space alliance."

The artificial earth satellite Intercosmos-1, which was launched in orbit on 14 October 1969, marked the beginning of investigation of the sun's short-wave radiation. The creative alliance of East German, Soviet, and Czech scientists

proved stable and fruitful. Scientific experiments were continued with Intercosmos satellites Nos 4, 7, 11, and 16. The Intercosmos-Kopernik 500 satellite can also be included in the "solar" family. At the same time this satellite belongs to the ionosphere group of Intercosmos satellites, the first of which were Nos 2 and 8.

Experiments conducted by Bulgarian, East German, Romanian, Soviet, and Czech scientists with the aid of the Intercosmos-12 satellite were also devoted to study of the ionosphere and upper atmosphere of the earth. Hungarian and Czech specialists studied streams of micrometeorites. Scientists from East Germany, the Soviet Union, and Czechoslovakia used the Intercosmos-10 satellite to study questions of the electromagnetic relationship of the magnetosphere and the ionosphere. The highly complex instrumentation installed in the Intercosmos-14 satellite enabled Bulgarian, Soviet, and Czech specialists to study low-frequency radiation and its relationship to the parameters of ionospheric plasma. Soviet-Czech studies made between 1970 and 1975 using Intercosmos satellites Nos 3, 5, and 13 produced a great deal of scientific information on the radiation situation in the space around the earth and dynamic processes in the earth's radiation belts.

These experiments were carried out using standardized space devices designed to solve a broad range of scientific problems. While they had a common design concept, they were subdivided into numerous modifications.

In 1976 the pioneers of the Intercosmos program were replaced by a spacecraft of a fundamentally new type, the automatic universal orbiting station (AUOS). Its technical capabilities are many times broader. This enabled scientists to design more sophisticated and intricate scientific complexes. The first was the Intercosmos-15. All the service systems and design elements of the new craft were tested during its flight. The Unified Telemetric System developed by Hungarian, East German, Polish, Soviet, and Czech specialists received its baptism at the same time. It enabled participants in scientific experiments to receive telemetric information directly from ground stations located in the territory of these countries.

The Intercosmos-17 automatic universal orbiting station was launched in September 1977. Hungarian, Romanian, Soviet, and Czech scientists conducted a comprehensive experiment to study charged particles of magnetospheric and galactic origin. A year later the 18th satellite in the series was launched in orbit within the program "International Investigation of the Magnetosphere." Its complex of scientific instruments developed by Hungary, Poland, Romania, the Soviet Union, and Czechoslovakia made it possible to carry out investigations of the nature of the electromagnetic relationship between the earth's magnetosphere and ionosphere and to study the characteristics of the propagation and interaction of low-frequency radio waves in ionospheric-magnetospheric plasma.

The first Czechoslovakian artificial earth satellite, called the Magion, was put in space along with it. On 14 November 1978 on command from earth it separated from the Intercosmos-18 and began an experiment to study the space-time structure of low-frequency electromagnetic fields in ionospheric-magnetospheric plasma (this is the origin of the name "Magion") by synchronous measurements of

the same parameters at two disconnected points in space. The joint experiment continued for about two weeks. During this time the two satellites gradually moved away from one another to a distance of 1,000 kilometers.

The study of the structures of our planet's ionosphere, its interactions with the sun's waves, emissions, and streams of corpuscles, and the characteristics of wave processes and the propagation of radio waves in the ionospheric plasma was continued by Bulgarian, Polish, Soviet, and Czech scientists and specialists using the Intercosmos-19 station.

Bulgarian scientists are making a substantial contribution to study of the magnetosphere and ionosphere. They have designed and built numerous instruments on a high scientific and technical level. The launching of the Intercosmos-Bulgaria 1300 on 7 August 1981, dedicated to the anniversary of Bulgarian statehood, was a major event in Soviet-Bulgarian cooperation.

The experiments conducted using Vertikal' research rockets significantly enrich and supplement the scientific results obtained from the Intercosmos series satellites. During the swift-passing minutes of work in space the scientific instruments installed in the rocket are able to record numerous parameters of the ionosphere and upper atmosphere, giving scientists a detailed picture of their vertical cross-section. Comparing these findings with analogous satellite measurements makes it possible to obtain a picture of the space around the earth and understand the phenomena and processes taking place in it more profoundly.

While speaking about international experiments in space, we cannot overlook the participation of Czech specialists in studies of the solar wind and the earth's radiation belts conducted using Soviet automatic Prognoz stations.

The field of space biology and medicine has a broad range of scientific research. Projects are being carried on in three principal areas: physiology under conditions of space flight; radiation safety in space and pharmacological-chemical protection of members of space expeditions; and space psychology. These problems are intimately linked to human beings spending time in space. The scientists of the socialist countries are studying the vestibular stability of the human organism, its biological rhythms, and much more. They are improving existing methods of selecting and training cosmonauts and developing new methods, and they are looking for ways to reduce the time required for them to adapt to space conditions and to readapt upon return to earth. Experiments on various animals are being conducted to improve protection against space radiation. The comprehensive biomedical experiment conducted by specialists from countries participating in the Intercosmos program using Cosmos satellite Nos 690, 782, 936, and 1129 was devoted to solving many pressing problems.

All spheres of the national economy depend on climatic and weather conditions to some degree. Studying and forecasting weather and the climate take up a significant place in work done under the cooperative program. In addition to a broad network of ground weather stations in the socialist countries, the scientific information from Soviet Meteor satellites is now put at the service of the scientists. It surpasses the information received from ground equipment by

several times in volume. After all, the satellites are able to transmit weather data to us over the waters of the world ocean. Scientists from the socialist countries participate regularly in the launching of MR-12, MMR-06, and M-100 weather rockets in the USSR. Complex optical instruments have been designed that make it possible to measure the vertical profile of the earth's ozone layer and the turbidity of the atmosphere. Joint theoretical development work is underway. All these things have greatly enriched our knowledge of the interaction of the earth's atmosphere and hydrosphere and the processes of heat exchange and radiation balance in the space around the earth.

Satellite communications equipment now provides regular television and telephone-telegraph radio communication among the socialist countries. A working group has compiled a future plan of scientific research and technical development in the field. Specifically, during performance of the program last year a multilateral agreement was signed under the title "Agreement on Building an International Complex To Conduct Experimental Projects Related to Using New Frequency Ranges for Fixed Satellite Communications System and Satellite Television Broadcasting Systems."

One of the most important research areas for applied purposes is remote sounding of the earth by aerospace means.

In September 1976 during the flight of the Soyuz-22 spacecraft a major scientific experiment prepared under the Intercosmos program by East German and Soviet specialists was carried out. An MKF-6 multizone camera mounted on board the ship made it possible to take pictures of our planet that were suitable for machine processing and interpretation. At the present time the Bulgarian Spektr-15 spectrometer is used in addition to the MKF-6M.

The flights of the Intercosmos satellites Nos 20 and 21 were linked to the problems of studying the world ocean. During these flights the system designed by Hungarian, East German, Polish, Soviet, and Czech scientists for collection and transmission of information was put through flight testing. Using this system the satellite receives information from automatic transmitter platforms located at the most varied points on earth and transmits them operationally to special receiving stations located in the countries participating in the study.

The meeting of representatives of Bulgaria, Hungary, East Germany, Cuba, Mongolia, Poland, Romania, the USSR, and Czechoslovakia in Moscow in July 1976 marked the beginning of a radical new stage in the development of the Intercosmos program. At this meeting the Soviet delegation presented a proposal to prepare for and carry out flights in Soviet craft and stations with participation by cosmonauts of the other socialist countries participating in the program. International crews carried out a broad set of physico-technical, technological, and biomedical studies and experiments on remote sounding of the earth from space from the Salyut-6 station. The resulting material is being used for scientific purposes and in different economic sectors of our countries. In particular, good results have been obtained in the newest subject area of the Intercosmos program, space material science.

The Intercosmos program is a graphic and vivid demonstration to the entire world of the invincible strength of the countries of the socialist community and the clarity of the challenges that face them.

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CSO: 1866/87

LEADING SPACE SCIENTISTS MEMORIALIZE LIFE OF S. P. KOROLEV

Moscow ZEMLYA I VSELENNAYA in Russian No 2, Mar-Apr 82 pp 48-51

[Article by V. P. Glushko, academician, chief designer of engines, and N. A. Pilyugin, academician, chief designer of control systems]

[Text] The "Nauka" Publishing House is making ready for publication a book entitled AKADEMIK S. P. KOROLEV. UCHENYY. INZHENER. CHELOVEK. (TVORCHESKIY PORTRET PO VOSPOMINANIYAM SOVREMENNIKOV) (Academician S. P. Korolev. Scientist. Engineer. Man (Creative Portraits From Recollections of Contemporaries)). The chief editor is Academician A. Yu. Ishlinskiy. The documentary content is under the direction of G. S. Vetrov, doctor of technical sciences, with the participation of Ye. A. Tumovskiy.

The book was compiled from the recollections of the colleagues of Academician S. P. Korolev and people close to him during different periods of life. The authors of these recollections are leading scientists, the directors of industry, Party and Soviet workers, engineers and workmen, childhood friends and relatives of S. P. Korolev.

The book gives a wide variety of episodes from the scientific biography of S. P. Korolev, reflections concerning his creative style, scientific principles and his human qualities.

Below we publish recollections by two very close colleagues of S. P. Korolev -- Academician V. P. Glushko, chief designer of engines, and Academician N. A. Pilyugin, chief designer of control systems.

***

Academician V. P. Glushko. The boy Sergey was born at Zhitomir on 12 January 1907, the son of a teacher. Sergey passed his years of youth in the southern Ukraine. In 1924 he graduated from the Odessa Professional-Technical Construction School. In those years it was customary for the graduates of intermediate schools to learn a trade. And thus Sergey Pavlovich became a specialized worker -- a tiler.

(The reliability of what I have said can be confirmed on the basis of my own personal experience since I also received an intermediate education in Odessa; I graduated in 1924 from the Professional-Technical School, but not in the

construction trades, but as a metal worker. I received my diploma after I had worked for half a year on the job at a factory producing hydraulic fittings -- first as a metalsmith and then as a lathe operator.)

In 1930 Sergey Pavlovich graduated from the Aeromechanical Faculty of the Moscow Higher Technical School in the aircraft construction field of specialization. Sergey Pavlovich combined study with work at the factories of our young, then only developing aviation industry. He began to work at aircraft factories in 1927, first as a technician, then as an engineer, a tester of new aircraft and as a group leader.

Between 1928 and 1930 Sergey Pavlovich completed studies at a school for glider pilots and a school for soaring pilots (receiving certificate No 12 as a soaring pilot -- one of the first in the USSR).

During these years Sergey Pavlovich combined work as a design engineer and test pilot, participated in the development and testing of the first models of new aircraft, working under the direction of outstanding designers, such as A. N. Tupolev, A. D. Grigorovich and N. N. Polikarpov.

While still a student, Sergey Pavlovich in 1923 had designed a glider; later he constructed several gliders and light aircraft of his own design: the "Koktebel'" glider (in collaboration with S. N. Lyushin), in which in 1929 the pilot K. K. Artseulov set an all-union record for flight range; a glider of a new type, the SK-3, the "Krasnaya Zvezda," in which the pilot V. A. Stepanchenok for the first time in history in October 1930 performed a "dead loop" and other maneuvers. We should also mention the light two-seat SK-4 sports aircraft with a Walter engine with a power of 60 HP, intended for long-range flights, created in 1929 and tested by the flier D. A. Koshits.

Sergey Pavlovich defended the design of this aircraft as a diploma project when graduating from the Moscow Higher Technical School.

Acquaintance with the studies and ideas of K. E. Tsiolkovskiy made a great impression on Sergey Pavlovich.

Beginning in 1931, while still working in the aviation industry, Sergey Pavlovich began investigations in the field of rocketry -- in the Osoaviakhim (Society for Promotion of Self-Defense and Aero-Chemical Industry) circle of enthusiasts.

It should be noted that in those years, and indeed, in many years which followed, not everyone acknowledged that rocketry had a right to exist. It was of interest only to enthusiasts who were condescendingly called "lunatics." Representatives of different branches of science, at best, related to such people with a smile.

During this period the work done by Sergey Pavlovich which was of the greatest interest was in the group for study of rocketry (GIRD -- Gruppa Izucheniya Reaktivnogo Dvizheniya [an abbreviation which in Russian also derisively was translated as "Group of Engineers Working in Vain]) in the Osoaviakhim.

Initially this was a group of public-spirited enthusiasts. It included F. A. Tsander, A. I. Polyarnyy, M. K. Tikhonravov, B. I. Cheranovskiy, Yu. A. Pobedonostsev, M. S. Kisenko, S. P. Korolev.

Later the GIRD was combined with the Gas-Dynamics Laboratory (GDL -- Gazodinamicheskaya Laboratoriya); the first rocket institute in the USSR -- the RNII -- was established on their basis.

In the GIRD Sergey Pavlovich participated in creating the OR-2 engine, and then in the construction and launching of the first Soviet liquid-fueled rocket.

At the GIRD and RNII Sergey Pavlovich was concerned with winged long-range rocket vehicles. Some experimental rockets (Nos 216, 217, 212, 48 and others) were tested in flight.

In 1935 Sergey Pavlovich developed and constructed the two-seat glider SK-9 for towed flights and in this glider (as pilot) he made a flight from Moscow to Feodosiya and back to Moscow. The towing vehicle was a P-5 aircraft. Then a liquid-fuel rocket engine was installed on this glider; the RP-318 single-place rocket glider with a flight weight of 700 kg appeared. Initially it carried the ORM-65 experimental engine and later a modification of this engine. On 28 February 1940 V. P. Fedorov in the rocket glider made a flight with a duration of 110 seconds. This was the first manned flight in the USSR in a vehicle with a liquid-fuel rocket engine (ZEMLYA I VSELENNAYA, No 6, pp 58-61, 1978 -- Editor).

On my request S. P. Korolev was sent to us at the Special Design Bureau. He zealously took on himself the direction of specialists involved in the installation of our engines on military aircraft, with his talent manifesting itself in all its splendor. Between 1942 and 1946 S. P. Korolev was deputy chief designer of the Special Design Bureau for flight tests.

While still at the RNII we were linked by our devotion to our beloved task and common interest in cooperation: flight vehicles were developed under the direction of Sergey Pavlovich and engines for them were developed under my direction.

During 1942-1943 Sergey Pavlovich developed an auxiliary rocket engine for the Pye-2 aircraft, using the RD-1 liquid-fuel rocket engine with pump feed. The RD-1Kh3 successfully underwent testing in a Pye-2R aircraft in 1945. Sergey Pavlovich not only was the designer of the aircraft part of the rocket engine and the entire complex of the surface fueling and launching equipment, but also as an experimental engineer personally participated in the flight testing of the apparatus.

In connection with the successful completion of stand and flight tests of the RD-1Kh3 engine the staff personnel of our Special Design Bureau, including Sergey Pavlovich, were awarded decorations in 1945.

We should mention a series of very interesting scientific investigations of the high layers of the atmosphere; on the request of the USSR Academy of Sciences they were carried out using rockets. The apparatus and experimental

animals in this case were returned to the earth. It is difficult to overevaluate the scientific importance of such studies, carried out jointly by the personnel of the Special Design Bureau headed by S. P. Korolev and the institutes of the USSR Academy of Sciences.

There is no need to continue the long list of design innovations developed under the direction of Sergey Pavlovich. I note only that these developments were made at a high scientific and engineering level. The Soviet government and the USSR Academy of Sciences highly regarded the work of Sergey Pavlovich. Twice, in 1956 and in 1961, he was awarded the title of Hero of Socialist Labor and he was elected a full academician of the USSR Academy of Sciences.

Sergey Pavlovich had behind him much experience in creative work in the development of flight vehicles. This served as a good foundation for subsequent development work in the rocketry field.

His talent as a scientist and engineer, his outstanding organizational capabilities -- these were the ingredients of the success of Sergey Pavlovich in his difficult work. I would especially like to emphasize the purposefulness and persistence characteristic for all his activity.

For me it is easier to judge Sergey Pavlovich since my work with him occurred under different circumstances. We met for the first time in 1932 when Sergey Pavlovich and a group of GIRD workers visited the Gas-Dynamics Laboratory to become acquainted with the work of the laboratory and on a stand demonstrated a liquid-fuel rocket engine in operation.

We cannot pass over the personal courage of Sergey Pavlovich, manifested by him during the flight tests of the RD-1 and RD-1Kh3 engines. On the aircraft the final tests of these engines by no means always passed smoothly, especially during the start-up of engines at great velocities and flight altitudes. There were several cases when the engine exploded during an attempt at its firing and damaged the aircraft's tail assembly to such an extent that it was surprising that the pilot had the skill to land the aircraft at the airport. The behavior of Sergey Pavlovich, personally participating in the flights, after we engine specialists had experienced such accidents, gained him great respect.

In speaking of the gifts of Sergey Pavlovich, it should not be forgotten that on our part, on the part of we chief designers, it would be fundamentally incorrect to attribute work success only to the personal qualities of a chief designer. In our era of complex, multisided technology all individual attempts to create any machines are doomed to failure.

Accordingly, in noting the merits of Sergey Pavlovich, among which we must unquestionably include his organizational talent, it is necessary to give their due to the personnel of the Special Design Bureau; after all, the staff in the last analysis is the direct creator.

Finally, we cannot remain silent about the extremely favorable conditions for creative work which were created by the Party and the government.

The question naturally arises: what place does Sergey Pavlovich occupy in Soviet rocketry?

After K. E. Tsiolkovskiy a valuable contribution to the development of the theory of rocket motion was made by two other talented countrymen of ours: Yu. V. Kondratyuk and F. A. Tsander. But they were not really able to create anything in the way of rockets. The work of other researchers who built and launched small, primitive rockets, was of an exploratory character and did not lead to the creation of rockets of practical importance. Sergey Pavlovich and the team which he directed, making use of Soviet and foreign experience, not only enriched theory but created rockets of the most perfect type for the particular level of technical development. Thus, with respect to his role in the history of Soviet rocketry Sergey Pavlovich occupies the first place after K. E. Tsiolkovskiy.

It must be noted that Soviet rocket-space technology was created by the chief designers (in the initial stage -- under the general direction of S. P. Korolev) with the involvement of branch and academic institutes and also many factories.

It is fitting to recall the contribution which was made by Academician M. V. Keldysh, from 1961 through 1975 heading the USSR Academy of Sciences, to the development of theoretical problems in cosmonautics, scientific research programs in space and providing them with instruments, bringing the institutes of the USSR Academy of Sciences to the aid of this work. The services of M. V. Keldysh are also important in that he actively supported the programs for the development of rocketry and cosmonautics in the USSR and participated in preparing them.

The decisive role in creating Soviet rocket-space science and technology was played by the high level of industrial development of the Soviet Union, the achievements of Soviet science and the self-sacrificing work of all the Soviet people, guided by the Communist Party and its Leninist Central Committee.

Academician N. A. Pilyugin. I consider myself lucky to have known Sergey Pavlovich Korolev and I worked with him for many years and with the team which he headed. Sergey Pavlovich was a great engineer, a leading organizer and without question an outstanding scientist. He was the founder of practical cosmonautics, both as a man laying the theoretical principles for the creation of space systems and as a man doing an exceptionally great amount of work for their practical realization.

I became acquainted with Sergey Pavlovich in the summer of 1945. All of us who were assigned work in the field of rocketry immediately sensed that he was a real organizer capable of bringing people together and getting them involved. From the first steps in the development of rocketry we met with great difficulties; frequently very important leaders refused to believe that success was possible. Such an attitude toward our work could be overcome in their time by D. F. Ustinov (now USSR Minister of Defense) and Marshal N. D. Yakovlev.

Sergey Pavlovich had all the qualities necessary for this new and highly important branch. In particular, I would like to note his considerate attitude toward people. In the case of failures he never made the team nor individual workers a "goat of sacrifice." As a man having great courage Sergey Pavlovich in such situations was able to create a truly working, creative situation and bring a large number of people to bear on the solution of difficult problems. But at the same time he did not tolerate slipshod work. He dealt with careless persons without mercy: "so that the work will proceed as it should," as he said in commenting on his actions.

Sergey Pavlovich knew how to stand up for those things which he deemed necessary and did not reckon with any obstacles, especially when the reliability of equipment was involved. In our work there was a case when assurance of a high reliability required the stoppage of production of objects for 8 months. Sergey Pavlovich insisted that the necessary conditions be created.

S. P. Korolev did not proceed headlong; he moved forward in short steps, but he took these steps frequently. As a result of such tactics in the course of a little more than 10 years outstanding successes were attained in the development and launching of the first artificial earth satellite.

I learned a great deal from Sergey Pavlovich. I would like to emphasize, in particular, that he knew how to select for himself not only deputies and assistants, but also successors. Sergey Pavlovich sought advice from the CPSU Central Committee and ministries; he consulted workers and all specialists. He was not afraid to throw into the water those who did not know how to swim. But when such a person floated up he was capable of great things.

Sergey Pavlovich was a crystal-pure communist. He thoroughly understood the need for maintaining peace on the earth. He expended many efforts in strengthening the defense capability of our country and the development of Soviet science.

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MEMORIAL ARTICLE HONORS ACADEMICIAN MIKHAIL KUZ'MICH YANGEL'

Moscow ZEMLYA I VSELENNAYA in Russian No 2, Mar-Apr 82 pp 51-53

[Article by P. I. Pavlov, professor: "Mikhail Kuz'mich Yangel': "On the 70th Anniversary of His Birth"]

[Text] The name of Academician Mikhail Kuz'mich Yangel' stands side-by-side with the names of well-known leaders in the field of cosmonautics. Only now, almost 11 years from the day of his death, are we really beginning to comprehend the depth of the scientific foresight of M. K. Yangel', the effectiveness of the direction which he developed in Soviet rocketry, in scientific and practical cosmonautics.

The son of an illiterate peasant from a Siberian village in the taiga, M. K. Yangel' graduated from the Moscow Aviation Institute and later from the Aviation Industry Academy. He rapidly won the reputation of being a highly qualified specialist in the field of creation of new types of aircraft. It is entirely possible that we might make a flight in a YaN if in 1950 M. K. Yangel' had not been designated a section head in the special design bureau headed by S. P. Korolev.

The new, vigorously developing branch of science and technology mercilessly swept away stereotypes in thinking; it required modern knowledge and bold solutions. M. K. Yangel' entered the field of rocketry with assurance. Like you enter into a house where they await you, where you are necessary. After only a year he became deputy to the Chief Designer, and in 1952 became director of the scientific research institute. A tireless, creative search led M. K. Yangel' to the thought that it was necessary to create a new direction in rocketry. He settled on his ideas not only as a scientist, but also as a communist and citizen precisely weighing all the "pros" and "cons," measuring his aspirations against the economic and political conditions in the country.

The proposals made by M. K. Yangel' found their support. In 1954 the CPSU Central Committee and the Soviet government entrusted him with direction of a major newly established experimental design bureau. He devoted his life to this task, which revealed all facets of his talent as a Chief Designer. Here, in the design bureau, he twice became a Hero of Socialist Labor, a winner of the Lenin and State Prizes, an academician, a deputy of the USSR Supreme Soviet, a candidate-member of the CPSU Central Committee.

M. K. Yangel' possessed fundamental theoretical knowledge, exceedingly rich experience in production, an unusually well-developed sense of new things, purposefulness, good organizational capabilities, ability to concentrate and personal charm, in other words, everything which we call the talent of a leader. He also coordinated and directed the efforts of many scientific research organizations and industrial enterprises, he headed the work of a key design bureau, and solved complex technical problems in introducing developments into production and carrying out flight tests.

The process of creating rockets requires the solution of a wide range of scientific and technical problems related primarily to the development of rocket engines and control systems, predetermines the need for profound investigations in the fields of strength, aerodynamics, materials science, heat exchange and other disciplines. The team headed by M. K. Yangel', in collaboration with the personnel of other specialized experimental-design bureaus, institutes of the USSR Academy of Sciences and branch institutes, successfully coped with these tasks.

Success does not come easy. There was work, bringing joy, but with a debilitating effect. The work was every day, and frequently every night. But already the first machine created by the young staff of the design bureau under the direction of M. K. Yangel' confirmed the correctness of the route selected in rocket technology. It became the prototype and foundation for creating new, more modern models.

The "Cosmos-1" artificial earth satellite was launched in the Soviet Union in March 1962. The design and technical specifications of the two-stage carrier-rocket and many satellites of this series were developed in the design bureau under the direction of M. K. Yangel'. The selected technical solutions made it possible to create a reliable, conveniently operating and economical complex. This complex, on the proposal of Mikhail Kuz'mich, made use of technical principles, assemblies and systems successfully checked in flight tests in the prototype of the carrier-rocket.

The flights of artificial earth satellites of the "Cosmos" series afforded Soviet scientists new possibilities for study of physics of the upper layers of the atmosphere and space (ZEMLYA I VSELENNAYA, No 1, pp 22-26, 1982 -- Editor).

A major creative achievement of the design bureau staff became the creation of a series of standardized space vehicles of the "Cosmos" series, including the development of universal servosystems and satellite designs, which were not dependent on the makeup of the new scientific apparatus and the problems to be solved by it. Standardization determined the approach to solution of technological problems: it became possible to use permanent technical gear and test equipment. For the first time in world practice satellites for scientific research began to be fabricated in series, which substantially reduced material expenditures. This once again revealed one of the principal technical concepts of M. K. Yangel': economic indices are the principal criteria in new development work.

The program for further space research constantly required improvement of scientific apparatus and the upgrading of different systems of artificial earth satellites. The design bureau of Academician M. K. Yangel' illustriously coped with solution of fundamentally new scientific and technical tasks. For the first time in history it was possible to develop an aerogyroscopic orientation system ensuring continuous triaxial stabilization of a vehicle in low orbits. A passive magnetic system for damping a satellite by means of dry friction forces was created for the first time, this making possible the intensive extinction of initial angular velocities. A theoretical basis was created demonstrating the possibility of creating a gravitational orientation system for space vehicles with a great range of altitudes. After modification such systems were developed and tested in flight.

The entire world with amazement observed the successful flights of international crews under the "Intercosmos" program. And the "Intercosmos-1" satellite, launched on 14 October 1969, became the "first swallow" of the international space cooperation. The implementation of the "Intercosmos" program required space vehicles differing considerably with respect to all principal characteristics: quantity and mass of scientific equipment, volume of recorded information, accuracy in orientation and stabilization, active lifetime and orbital parameters. Together with kindred organizations, the design bureau specialists successfully carried out their new tasks. More perfect and powerful than the first representative of this series, the "Intercosmos" carrier-rocket began to put large automatic universal stations into orbit. Academician B. N. Petrov stated: "Every time that the next satellite of the 'Intercosmos' series is guided into flight you involuntarily think that in the momentum which guides the satellite into orbit there is a small fraction of the creative energy of Mikhail Kuz'mich Yangel'."

M. K. Yangel' always regarded the training of scientific and technical personnel to be one of the most fundamental tasks. In every way possible he encouraged creative search and bold innovative ideas; he implanted in his colleagues assurance of their own powers and the desire to make independent decisions. The Chief Designer resolutely adhered to the idea of creating a scientific council and graduate-level study in the design bureau and in every way possible facilitated this coming to pass. Being a member of the scientific councils of a number of higher institutions of education, he guided the preparation of candidate's and doctor's dissertations on the most timely themes in this branch of science. Later many of his students became leading scientists, directors of planning and design organizations and scientific research institutes.

In the late 1950's M. K. Yangel' wrote: "The modern rocket and interplanetary ships of the future -- these are primarily means of scientific and technical research. The data obtained as a result of modern scientific research constitute the basis of the scientific and technical progress of tomorrow. That which we have learned today only in its general outlines will tomorrow be put to practical use."

The design bureau, fostered by Mikhail Kuz'mich Yangel', continues to work successfully on creating increasingly more perfect rocket-space systems. Bringing to life the ideas and thoughts of Academician M. K. Yangel', his comrades,

followers and students are making a worthy contribution to the further flourishing of Soviet science and technology. Their motto in their quest and in their achievement remains the words of the Chief Designer: "Serve the people, be useful to the Motherland -- this is not only duty, but the meaning of life."

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PRAVDA ON U.S. MILITARIZATION OF SPACE

Moscow PRAVDA in Russian 2 Jul 82 p 4

[Article by G. Stakh: "For Peaceful Space"]

[Text] In implementing the program for peace in the eighties worked out by the 26th CPSU Congress, the USSR had advanced a whole complex of practical proposals aimed at halting the arms race and ensuring implementation of measures of real disarmament. The USSR's pledge not to be the first to use nuclear weapons, which was announced in Comrade L. I. Brezhnev's message to the Second Special Session of the UN General Assembly on Disarmament, is of historic significance. The USSR's memorandum "To Avert The Growing Nuclear Threat, To Curb the Arms Race," which was also submitted to the forum for examination, sets forth our country's concrete proposals on these vital problems of the present day.

Among the measures contained in the memorandum, which are aimed at eliminating the danger of a nuclear war, an important place is occupied by a USSR proposal to ban placement of all types of weapons in space. The significance of this initiative is obvious.

Washington's sinister plans to use space for its agressive purposes are manifested more clearly every day. These plans were reported in particular by the newspaper THE NEW YORK TIMES, according to whose testimony the U.S. space program has been placed in the service of the Pentagon.

Spreading the arms race to space is being linked by those across the ocean in particular to the possibility of utilizing reusable manned craft. The Pentagon places great hopes on the "Shuttle" type system, which is undergoing "Columbia" program test flights. During a regular test flight of this spacecraft, a "top secret" military cargo was placed aboard and astronauts were assigned specific military tasks.

This cargo includes an infrared range telescope and ultraviolet range scanning sensors for detecting "hostile" missiles and space devices. There are plans to use both of these installations in the Pentagon's military satellites. A space sextant, intended for independent determination of coordinates by military aircraft, was also tested.

It has been estimated in the United States that up to 1994 the Pentagon will need 114 flights of the "Shuttle" series reusable manned craft to carry out in practice its tasks with regard to massed use of space for military purposes. During the initial stage this applies to placing military satellites in orbit and servicing them. In the future it is planned to considerably expand the sphere of utilization of this type of devices for military purposes.

All of this lends a more dangerous and a qualitatively new character to the arms race. The creation and placement of military space systems in near-earth orbit are viewed in Washington as a "prospect" in the pursuit by the United States to achieve military supremacy over the USSR and to undermine the established strategic balance. The more agressive circles across the ocean make no secret of the fact that these are the goals behind the verbiage emanating from Pentagon strategists on the need for the United States to assume a predominant position in space. Gen. B. Randolph, director of the U.S. Air Force space systems, recently said: "Space is a modern equivalent of those 'heights' which military leaders strived to have control over for centuries in order to use them in achieving superiority."

Details are unnecessary in saying that estimations for achieving American supremacy in space are as unfounded as the plans for ensuring military superiority on earth.

Being a recognized pioneer of peaceful space exploration, the USSR, of course, has at its disposal the necessary scientific and technical means and economic potential to appropriately counteract such plans and to insure its own security and the security of its allies and friends. The Soviet Union, Comrade L. I. Brezhnev warned, "will find the possibility of responding rapidly and effectively to any challenge that one may want to throw at us."

Nevertheless, Washington's plans for achieving superiority in space are a great danger to mankind. American military and political figures, including those at the highest level of the present administration have been publicly proposing various methods of waging a nuclear war--from a "limited" to an all-out one. One cannot fail to see a direct connection between Washington's military space ambitions and the agressive military and political doctrines--one being more adventurisitc than the other--being advanced there officially, which proceed from "permissibility" of a nuclear war and the possibility of "gaining" victory in it. Under these conditions, practical implementation of the plans for placing military systems in space, which are being nutured by the Pentagon, would have a dangerous destabilizing influence on the entire strategic situation. Washington's space militarization plans considerably intensify the threat of a nuclear conflict breaking out.

As regards the Soviet Union, it has repeatedly declared that it stands firmly for preserving strategic stability and for maintaining the established military balance. A striking demonstration of this is the USSR's pledge not to be the first to use nuclear weapons. The Soviet Union is ready to come to

an agreement on limiting and banning any types of weapons, of course, on a mutual basis and adherence to the principle of equality and equal security of the sides.

During the past several years, international agreements blocking certain channels of space for military use have been reached as a result of Soviet efforts, which were supported by other peace-loving states. Testing nuclear weapons in space, placing any device with nuclear weapons or any other type of weapon of mass destruction into orbit around the earth and installing such weapons on celestial bodies and placing them in space by any other means have been banned. Using means of influence from space on the earth's natural environment and on outer space for military purposes has also been banned. The USSR and the United States have also pledged not to test and develop space based missile systems or components in accordance with the agreement on limiting anti-missile defense (1972).

In pursuing the illusion of military superiority, the United States, as it has done repeatedly in the past, comes forward as an instigator of creating new types of weapons, this time of a space variety. But the arms race in this direction directly contradicts vital interests of the people and the goal of preserving peace on the planet. The Soviet Union believes that spreading the arms race to outer space must not be allowed and that it is necessary to avert competition for creating space weapons.

The 36th Session of the UN General Assembly has supported by an absolute majority of votes the USSR's initiative on concluding an agreement to ban placing all types of weapons in outer space and assigned the Disarmament Committee to urgently begin elaborating such an agreement. It is necessary that the Disarmament Committee begin elaborating a corresponding international agreement without delay.

The entire experience in negotiating in the field of disarmament indicates that it is much easier to come to an agreement on banning one or another type of system of weapons before they are deployed at military sites.

The Soviet Union calls upon the international community to promptly adopt measures so that space can be free from all types of weapons forever and not be transformed into a source of military danger.

However, practical negotiations on this important problem have not begun yet as a result of opposition by the United States and some of its NATO allies in the Disarmament Committee. Even a working organ of the committee to conduct negotiations has not been established for the same reason. Counting on the expansion of the arms race to space, Washington has been obstructing the drawing up by the Disarmament Committee of an agreement to ban placing all types of weapons in space. The American side also does not show any interest in resuming talks conducted between the USSR and the United States during the 1978-79 period on antisatellite systems as well as on some other aspects of arms limitation which were broken off by Washington.

The Soviet Union is for the earliest possible beginning of businesslike, practical talks in the Disarmament Committee on solving the entire problem of averting the arms race in space. The question of antisatellite systems must be viewed there in the context of other measures aimed at achieving this goal.

The Second Special Session of the UN General Assembly on Disarmament can also make a substantial contribution to solving this important task by demanding prompt fulfillment of recommendations contained in the concluding document of the First Special Session on Disarmament Problems on the necessity of adopting appropriate measures and of holding international talks aimed at averting the arms race in outer space. The Disarmament Committee's efforts must be given a new impulse.

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SOVIET-FRENCH PROGRAMS CONTRASTED WITH U.S. MILITARIZATION OF SPACE

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 1 Jul 82 p 3

[Article by G. Dad'yants: "Peace or War in Space?"]

[Text] The flight of the orbital scientific research complex "Salyut-7"-"Soyuz T-5"-"Soyuz T-6" is continuing. It has attracted attention of the world and particularly of the West European public. For the first time a representative of West Europe is aboard the Soviet scientific research complex. He is Jean-Loup Chretien, a French citizen. "For the first time in the history of cosmonautics," says a message from French president F. Mitterrand, "a French cosmonaut has an opportunity to begin scientific experiments of great importance as a result of cooperation with the USSR."

Of course, first of all, the flight is of a scientific-technical significance. But the conversation is about an important stage in Soviet-French space cooperation, which is not in its first year. "Since 1966 when the de Gaulle government laid a foundation for this cooperation," Jean-Pierre Chevenement, French minister for scientific research and technology, said to Agence France-Presse, "it allowed 24 groups of French researchers to carry out 138 experiments of a very high scientific level and made it possible for French scientific centers to participate in important research programs on the planets and interplanetary space."

In this connection let us recall the cooperation in polar thermosphere research on Hayes Island, the annual launchings of meteorological rockets and laser probing of the solar cycle with the aid of French equipment, the utilization of Soviet electron guns and French instruments in the "Araks" project to measure wave and particle characteristics and the French experiments aboard the Soviet apparatus sent to Mars. French made laser reflectors were installed on Soviet "Lunokhod" devices.

It is no wonder that the French journalists accredited in Moscow and those who made a special trip for the occasion from Paris have, first of all, noted in their correspondences the high technical corrdination and accuracy of work during the period of preparations for and launching of the spaceship Soyuz T-6 and have described in detail the docking, the crew's work conditions aboard the space complex and the medical, biological and other scientific-technical experiments, including those conducted by the French cosmonaut aboard the orbital station.

There is another aspect of the flight--a political one. This flight is taking place during a complex international situation when the U.S. administration, in an attempt to rekindle the "cold war," is putting hard pressure on its West European allies by forcing them to curtail a mutually advantageous cooperation with the socialist countries, including the field of science and technology. "The White House," notes LE MONDE, "is obviously displeased with the Soviet-French spaceflight and if it had the means to exert pressure (similar to those it is using to frustrate the agreement on gas pipeline construction which is to supply natural gas to West Europe) there is no doubt that it would have used them."

Therefore, the political significance of the joint flight of Soviet and French cosmonauts is, first of all, that it expresses a striving by the USSR and France to continue peaceful cooperation in space and in other fields as well whether or not it pleases the White House. The flight symbolizes, as L. I. Brezhnev stressed in his congratulations to the international crew, "traditional friendship between the Soviet and French people and is a striking example of fruitful cooperation in the peaceful use of outer space."

Can one regard as a mere coincidence the fact that while the Soviet and French cosmonauts have been working for peaceful purposes aboard the orbital station, the American space shuttle Columbia was completing its fourth consecutive test flight for the needs of the Pentagon? A military cargo aboard the Columbia has been labelled "top secret" by the Pentagon. According to available data, this applies to a telescope and scanning sensors for detecting "hostile" missiles and space devices. This is the Reagan administration's obvious step along the path of militarization of outer space. Military satellites and so-called "killer-satellites" will be placed in orbit with the aid of "Shuttle" type ships during the initial stage. Subsequently it is planned to launch laser weapons in space.

Can the world community, in comparing the flights of "Salyut-7", Soyuz T-5" and "Soyuz T-6" with Columbia, stop wondering where the development of world cosmonautics will lead? France, notes the Paris press, has counted on active peaceful space cooperation with the Soviet Union during the past 15 years. Jean-Loup Chretien's flight is simply a logical continuation of long-standing teamwork, numerous meetings between scientists of both countries and an established atmosphere of trust without which it is impossible to succeed in anything. But the United States is spreading an atmosphere of distrust not only on earth but also in space and wants to transform space into an object of military opposition to the USSR. QUOTIDIEN DE PARIS carries reports on the two space flights under the headings "No Secrets on the Soyuz Mission" and "Columbia's Military Secrets."

We are aware that there are still people in France who would prefer to compete in policy with ships of the "Shuttle" type instead of the complexes of the "Salyut-7", "Soyuz T-5" and "Soyuz T-6" type. For this reason they are quite willing to at least reduce the significance of the current Soviet-French scientific experiment in space if not being silent about it altogether. But this is a vain attempt. We saw how crowds of Frenchmen watched on "TF-1" and

"Antenne-2" the launching of the Soviet spaceship, which in addition to Soviet cosmonauts also had France's first cosmonaut Jean-Loup Chretien aboard. We can understand why French is sometimes heard more loudly than Russian at the international press center in Moscow today. Manned flights in space are a routine matter for the Soviet Union, but the first "stellar hour" has just begun for France. And she is celebrating this not with the Americans but with us, the Soviet people.

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LIST OF RECENT SOVIET SPACE LAUNCHES

Moscow TASS in English or Russian various dates

[Summary]

Date	Designation	Orbital Parameters			
		Apogee	Perigee	Period	Inclination
27 Jul 82	Cosmos-1396	323 km	208 km	89.5 min	72.9°
29 Jul 82	Cosmos-1397	549 km	346 km	93.4 min	50.7°
3 Aug 82	Cosmos-1398	262 km	225 km	89 min	82.3°
4 Aug 82	Cosmos-1399	371 km	179 km	89.7 min	64.9°
5 Aug 82	Cosmos-1400	675 km	631 km	97.6 min	81.2°
20 Aug 82	Cosmos-1401	282 km	226 km	89.3 min	82.3°
30 Aug 82	Cosmos-1402	279 km	254 km	89.6 min	65°
1 Sep 82	Cosmos-1403	380 km	216 km	90.2 min	70.4°
1 Sep 82	Cosmos-1404	394 km	211 km	90.2 min	72.9°
4 Sep 82	Cosmos-1405	456 km	438 km	93.3 min	65°
8 Sep 82	Cosmos-1406	253 km	222 km	89 min	82.3°
		(Carries equipment for earth resources studies; data to be transmitted to Priroda State Research and Production Center for Processing and use)			
15 Sep 82	Cosmos-1407	364 km	181 km	89.7 min	67.2°
16 Sep 82	Cosmos-1408	679 km	645 km	97.8 min	82.5°

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